OPV-1500K

SERVICE MANUAL

Life Scope N
BEDSIDE MONITOR

OPV-1500

0634-001869B

NIHON KOHDEN

OPV-1500K

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BEDSIDE MONITOR

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Model: OPV-1500K

Manual code no.: 0634-001869B

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GENERAL HANDLING PRECAUTIONS

This device is intended for use only by qualified medical personnel.
Use only Nihon Kohden approved products with this device. Use of non-approved products or in a non-approved manner may affect the performance specifications of the device. This includes, but is not limited to, batteries, recording paper, pens, extension cables, electrode leads, input boxes and AC power.

Please read these precautions thoroughly before attempting to operate the instrument.

1. **To safely and effectively use the instrument, its operation must be fully understood.**

2. **When installing or storing the instrument, take the following precautions:**
   (1) Avoid moisture or contact with water, extreme atmospheric pressure, excessive humidity and temperatures, poorly ventilated areas, and dust, saline or sulphuric air.
   (2) Place the instrument on an even, level floor. Avoid vibration and mechanical shock, even during transport.
   (3) Avoid placing in an area where chemicals are stored or where there is danger of gas leakage.
   (4) The power line source to be applied to the instrument must correspond in frequency and voltage to product specifications, and have sufficient current capacity.
   (5) Choose a room where a proper grounding facility is available.

3. **Before Operation**
   (1) Check that the instrument is in perfect operating order.
   (2) Check that the instrument is grounded properly.
   (3) Check that all cords are connected properly.
   (4) Pay extra attention when the instrument is combined with other instruments to avoid misdiagnosis or other problems.
   (5) All circuitry used for direct patient connection must be doubly checked.
   (6) Check that battery level is acceptable and battery condition is good when using battery-operated models.

4. **During Operation**
   (1) Both the instrument and the patient must receive continual, careful attention.
   (2) Turn power off or remove electrodes and/or transducers when necessary to assure the patient's safety.
   (3) Avoid direct contact between the instrument housing and the patient.

5. **To Shutdown After Use**
   (1) Turn power off with all controls returned to their original positions.
   (2) Remove the cords gently; do not use force to remove them.
   (3) Clean the instrument together with all accessories for their next use.

6. **The instrument must receive expert, professional attention for maintenance and repairs. When the instrument is not functioning properly, it should be clearly marked to avoid operation while it is out of order.**

7. **The instrument must not be altered or modified in any way.**

8. **Maintenance and Inspection:**
   (1) The instrument and parts must undergo regular maintenance inspection at least every 6 months.
   (2) If stored for extended periods without being used, make sure prior to operation that the instrument is in perfect operating condition.

(3) Technical information such as parts list, descriptions, calibration instructions or other information is available for qualified user technical personnel upon request from your Nihon Kohden distributor.

9. **When the instrument is used with an electrosurgical instrument, pay careful attention to the application and/or location of electrodes and/or transducers to avoid possible burn to the patient.**

10. **When the instrument is used with a defibrillator, make sure that the instrument is protected against defibrillator discharge. If not, remove patient cables and/or transducers from the instrument to avoid possible damage.**

WARRANTY POLICY

Nihon Kohden Corporation (NKC) shall warrant its products against all defects in materials and workmanship for one year from the date of delivery. However, consumable materials such as recording paper, ink, stylus and battery are excluded from the warranty.

NKC or its authorized agents will repair or replace any products which prove to be defective during the warranty period, provided these products are used as prescribed by the operating instructions given in the operator's and service manuals.

No other party is authorized to make any warranty or assume liability for NKC's products. NKC will not recognize any other warranty, either implied or in writing. In addition, service, technical modification or any other product change performed by someone other than NKC or its authorized agents without prior consent of NKC may be cause for voiding this warranty.

Defective products or parts must be returned to NKC or its authorized agents, along with an explanation of the failure. Shipping costs must be pre-paid.

This warranty does not apply to products that have been modified, disassembled, reinstalled or repaired without Nihon Kohden approval or which have been subjected to neglect or accident, damage due to accident, fire, lightning, vandalism, water or other casualty, improper installation or application, or on which the original identification marks have been removed.

In the USA and Canada other warranty policies may apply.

EMC RELATED CAUTION

This equipment and/or system complies with the International Standard IEC60601-1-2 for electromagnetic compatibility for medical electrical equipment and/or system. However, an electromagnetic environment that exceeds the limits or levels stipulated in the IEC60601-1-2, can cause harmful interference to the equipment and/or system or cause the equipment and/or system to fail to perform its intended function or degrade its intended performance. Therefore, during the operation of the equipment and/or system, if there is any undesired deviation from its intended operational performance, you must avoid, identify and resolve the adverse electromagnetic effect before continuing to use the equipment and/or system.

The following describes some common interference sources and remedial actions:

1. **Strong electromagnetic interference from a nearby emitter source such as an authorized radio station or cellular phone:**
   Install the equipment and/or system at another location if it is interfered with by an emitter source such as an authorized radio station. Keep the emitter source such as cellular phone away from the equipment and/or system.

2. **Radio-frequency interference from other equipment through the AC power supply of the equipment and/or system:**
   Identify the cause of this interference and if possible remove this interference source. If this is not possible, use a different power supply.

3. **Effect of direct or indirect electrostatic discharge:**
   Make sure all users and patients in contact with the equipment and/or system are free from direct or indirect electrostatic energy before using it.

4. **Electromagnetic interference with any radio wave receiver such as radio or television:**
   If the equipment and/or system interferes with any radio wave receiver, locate the equipment and/or system as far as possible from the radio wave receiver.

If the above suggested remedial actions do not solve the problem, consult your Nihon Kohden Corporation subsidiary or distributor for additional suggestions.

In IEC 60601-1-2 Medical Electronic Equipment, Part 1: General Requirements for Safety, 2. Collateral Standard: Electromagnetic compatibility-Requirements and test. Section 36. 202. 2 Radiated radio-frequency electromagnetic fields, PATIENT COUPLED EQUIPMENT and/or SYSTEMS applicable IMMUNITY test methods are under consideration at SC62A/WG13. The 3 V/m IMMUNITY level may be inappropriate especially when measuring SpO_2 because physiological signals can be much smaller than those induced by a 3 V/m electromagnetic field.

When measuring SpO_2, various interference may produce false waveforms which look like pulse waveforms. SpO_2 value and pulse rate may be measured from these false waveforms, causing the alarm to function improperly.

When installing the monitor, avoid locations where the monitor may receive strong electromagnetic interference such as radio or TV stations, cellular phone or mobile two-way radios.

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.

For more information, see the FDA web site.
http://www.fda.gov/cdrh/safety.html

Conventions Used in this Manual and Instrument

Warnings, Cautions and Notes

Warnings, cautions and notes are used in this manual to alert or signal the reader to specific information.

WARNING

A warning alerts the user to possible injury or death associated with the use or misuse of the instrument.

CAUTION

A caution alerts the user to possible injury or problems with the instrument associated with its use or misuse such as instrument malfunction, instrument failure, damage to the instrument, or damage to other property.

NOTE

A note provides specific information, in the form of recommendations, prerequirements, alternative methods or supplemental information.

Explanations of the Symbols in this Manual and Instrument

The following symbols found in this manual/instrument bear the respective descriptions as given.

On panels

Symbol	Description	Symbol	Description
	Monitor power on		Home (monitoring screen)
	Monitor power off		Setting screen
	AC operation (front panel) Alternating current (rear panel)		Record start/stop (for optional recorder unit)
	Battery operation		Defibrillation-proof type CF applied part
	Battery charging		Defibrillation-proof type BF applied part
	Alarm silence		Attention, consult operator's manual
	NIBP		ZB-900PK transmitter socket
	NIBP interval		Output terminal
	NIBP start		Equipotential terminal
	NIBP stop		Year of manufacture
	Review		Serial number
	The CE mark is a protected conformity mark of the European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.		

On screen

Symbol	Description	Symbol	Description
	Alarm silence with remaining minutes		Body movement (SpO_2)
	Alarm off		Recording
	QRS/pulse sync mark		Recorder door open (when using optional recorder unit)
	Respiration sync mark		Out of paper (when using optional recorder unit)
	NIBP measurement on neonate		Transmitter connected to the monitor

Others

Symbol	Description	Symbol	Description
	Recycle (On battery pack)	IPX4	Splash-proof equipment (On transmitter)
	Manufacturer	EC REP	Authorized representative in the European Community
	The CE mark is a protected conformity mark of the European Community. The products herewith comply with the requirements of the Medical Device Directive 93/42/EEC.		

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Section 1 General

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Introduction

This service manual provides useful information to qualified service personnel to understand, troubleshoot, service, maintain and repair the Life Scope N OPV-1500 Series Hardwire Monitor (referred to as “monitor” in this service manual.

All replaceable parts or units of this monitor and its optional units are clearly listed with exploded illustrations to help you locate the parts quickly.

The “Maintenance” section in this service manual only describes the maintenance that should be performed by qualified service personnel. The Maintenance section in the operator’s manual describes the maintenance that can be performed by the user.

The information in the operator’s manual is primarily for the user. However, it is important for service personnel to thoroughly read the operator’s manual and service manual before starting to troubleshoot, service, maintain or repair this monitor. This is because service personnel needs to understand the operation of the monitor in order to effectively use the information in the service manual.

General Information on Servicing

Note the following information when servicing the monitor.

WARNING

To avoid the possibility of injury to yourself or damage to the monitor, do not install or remove any component while the power is on. When disassembling, make sure that the monitor is turned off and the power cord is disconnected from the monitor and AC outlet. There is a high voltage circuit on the inverter for the LCD backlight and power unit.

CAUTIONS

Safety

- **There is the possibility that the outside surface of the monitor, such as the operation keys, could be contaminated by contagious germs so disinfect and clean the monitor before servicing it. When servicing the monitor, wear rubber gloves to protect yourself from infection.**

- **There is the possibility that when the lithium battery, NiMH battery or LCD unit is broken, a solvent could flow out or a toxic substance inside it could come out. If the solvent or toxic substance contacts the eyes or skin, wash immediately and thoroughly with water and see your physician. Never rub your eyes, otherwise you may lose your eyesight.**

- **To avoid accidental electrostatic discharge which could damage the components of the monitor, use a grounded wrist strap when installing or removing any component of the monitor.**

- **Use a pair of clean cotton gloves when replacing the LCD unit. If it is damaged, your may get injured.**

Liquid ingress

The monitor is not waterproof, so do not install the monitor where water or liquid can get into or fall on the monitor. If liquid accidentally gets into the monitor or the monitor accidentally drops into liquid, disassemble the monitor, clean it with clean water and dry it completely. After reassembling, do the patient safety checks and function/performance checks to verify that there is nothing wrong. If there is something wrong with the monitor, contact your Nihon Kohden representative for repair.

Environmental Safeguards

Depending on the local laws in your community, it may be illegal to dispose of the lithium battery in the regular waste collection. Check with your local officials for proper disposal procedures.

Disinfection and cleaning

To disinfect the outside surface of the monitor, wipe it with a non-abrasive cloth moistened with any of the disinfectants listed below. Do not use any other disinfectants or ultraviolet rays to disinfect the monitor.

- **Chlorohexidine gluconate solution: 0.5%**
- **Benzethonium chloride solution: 0.2%**
- **Glutaraldehyde solution: 2.0%**
- **Benzalkonium chloride: 0.2%**
- **Hydrochloric alkyl diaminoethylglycine: 0.5%**

Transport

- **Use the specified shipment container and packing material to transport the monitor. If necessary, double pack the monitor. Also, put the monitor into the shipment container after packing so that the buffer material does not get inside the monitor.**
- **When transporting a board or unit of the monitor, be sure to put it in a conductive bag. Never use an aluminum bag to transport a board or unit. Also, never use a styrene foam or plastic bag which generates static electricity to wrap the board or unit of the monitor.**

Handling the monitor

- **Because the outside surface of the monitor is made of resin, the outside surface of the monitor is easily damaged. So when handling the monitor, remove clutter from around the monitor and be careful to not damage the monitor or get it dirty.**
- **Because most of the boards in the monitor are multilayer boards with surface mount electrical devices (SMD), a special tool is required to remove and solder the electrical devices on it. To avoid damaging other electrical components, do not remove and solder SMD components yourself.**

Measuring and Test Equipment

Maintain the accuracy of the measuring and test equipment by checking and calibrating it according to the check and calibration procedures.

Battery Pack

- **Before disposing of the battery, check with your local solid waste officials for details in your area for recycling options or proper disposal. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream.**

Service Policy, Service Parts and Patient Safety Checks

Service Policy

Our technical service policy for this monitor is to replace the faulty unit, board or part or damaged mechanical part with a new one. Do not perform electrical device or component level repair of the multilayer board or unit. We do not support component level repair outside the factory for the following reasons:

- Most of the boards are multilayer boards with surface mount electrical devices, so the mounting density of the board is too high.
- A special tool or high degree of repair skill is required to repair the multilayer boards with surface mount electrical devices.

Only disassemble the monitor or replace a board or unit in an environment where the monitor is protected against static electricity.

As background knowledge for repair, pay special attention to the following:

- To reduce the repair time, consider the problem before starting repair.
- To clarify the source of the troubles, use the information from the diagnostic check function of the monitor and the information described in the troubleshooting section.

Service Parts

Refer to “Replaceable Parts List” of this manual for the service parts for technical service that we provide.

NOTE

When ordering parts or accessories from your Nihon Kohden representative, please quote the NK code number and part name which is listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use parts and accessories recommended or supplied by Nihon Kohden Corporation to assure maximum performance from your monitor.

Patient Safety Checks

Periodic maintenance procedures and diagnostic check procedures are provided in this manual to ensure that the monitor is operating in accordance with its design and production specifications. To verify that the monitor is working in a safe manner with regard to patient safety, patient safety checks should be performed on the monitor before it is first installed, periodically after installation, and after any repair is made on the monitor.

For patient safety checks, perform the following checks as described in the IEC60601-1 “Medical electrical equipment - Part 1: General requirements for safety”.

- Protective earth resistance check
- Earth leakage current check
- Enclosure leakage current check
- Patient leakage current check
- Withstanding voltage check

Maintenance Equipments and Tools

Test equipment

When repairing or calibrating the monitor, the following test equipment is required.

- Oscilloscope: 2 channels or more for input signal, 50 mV to 5 V input range, 1/10 attenuating probe and 100 MHz or more frequency response characteristic must be provided.
- Digital voltmeter: standard type (An oscilloscope can be used instead of the digital voltmeter.)

General Safety Information

General

WARNING

- **Never use this monitor in the presence of any flammable anesthetic gas, concentrated oxygen or hyperbaric oxygen. Failure to follow this warning may result in explosion.**
- **Never use the monitor in a high-pressure oxygen medical care tank. Failure to follow this warning may cause explosion or fire.**
- **When using this monitor with an electrosurgery unit, its return plate and the electrodes for monitoring must be firmly attached to the patient. If the return plate is not attached correctly, it may burn the patient's skin where the electrodes are attached. Refer to the instruction manual for the ESU.**
- **When performing MRI tests, remove the electrodes and transducers connected to the monitor from the patient. The heat generated from the induced electromotive force may burn the patient's skin. For details, refer to the instruction manual for the MRI.**
- **When performing defibrillation, discharge as far as possible from electrodes and medicine on the chest of the patient. If there is a possibility that the defibrillator paddle could touch electrodes and medicine, remove electrodes and medicine from the patient. If the defibrillator directly contacts these materials, the discharged energy may cause serious electrical burn to the patient.**
- **Before performing defibrillation, check that the cords and cables of the electrodes and transducers attached to the patient are properly connected to the monitor. Touching the metal parts of disconnected cords and cables may cause serious electrical shock or injury by discharged energy.**
- **To avoid the risk of serious electrical burn, shock or other injury during defibrillation, all persons must keep clear of the bed and must not touch the patient or any equipment connected to the patient.**
- **During alarm suspension, all current alarms are temporarily turned off.**
- **When EXIT SLEEP MODE ON ALARM on the SYSTEM SETUP screen is set to NO, the bedside monitor alarm cannot be seen or heard on the bedside monitor during sleep mode. Attach the transmitter (option) to the monitor and monitor the bedside monitor alarm on the central monitor or telemetry system. Otherwise, bedside monitor alarms may be overlooked.**

CAUTION

- **Use only Nihon Kohden specified electrodes, probes and cuffs. Otherwise, the maximum performance from the monitor cannot be guaranteed.**
- **Do not reuse disposable parts.**

- **Turn off the power of cell telephones, small wireless devices and other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.**
- **Before monitoring a new patient, first delete all data of the previous patient. Otherwise, the data of the previous patient and new patient will be mixed together.**
- **Alarm recording is not performed when alarm is suspended or alarm recording is set to off.**
- **When the alarm limit is turned off, there will be no alarm for that parameter limit.**
- **When the "ECG CONNECTOR OFF", "SpO2 CONNECTOR OFF" or "AIR HOSE OFF" message appears on the screen, check that the connection cords are connected to the sockets properly. Patient cannot be monitored and the alarm does not function properly while this message is displayed.**
- **If fluids are accidentally spilled on the monitor, take the bedside monitor out of service and check for damage.**

Installation

WARNING

- **For patient safety, equipotential grounding of all instruments must be performed. Consult with a qualified biomedical engineer.**
- **Only use the provided power cord. Using other power cords may result in electrical shock or other injury to the patient and operator.**
- **When the provided power cord cannot be used or when equipotential grounding is doubtful (such as in poor grounding facility), operate the monitor on battery power.**
- **Connect only the specified instrument to the socket marked with ⚠ by following the specified procedure. Otherwise, electrical leakage current may harm the patient and operator.**

CAUTION

- **When connecting the monitor to other instruments, the connection must comply with IEC60601-1-1. Refer to "General Requirements for Connecting Medical Electrical System" in Section 13.**
- **Disconnect the power cord of all instruments from the AC SOURCE socket before connecting the instruments. Otherwise there may be an electrical shock.**
- **Avoid locations where the monitor and system may be sprinkled with water or chemical solutions. Otherwise the monitor and system may be damaged.**
- **When not using the KC-012P cart, make sure that the monitor is**

placed and fastened so that it does not tip over.

- **When the monitor power is turned on, check that one “bong” sounds and the red and orange alarm indicators blink once to show that the alarm functions properly.**

Also read the warning and caution in “Selecting a Suitable Location” in Section 2.

Using KC-012P Cart

CAUTION

- **Use only the KC-012P cart for the OPV-1500K bedside monitor. If another cart is used, it may tip over or the monitor may fall off.**
- **When the monitor is mounted on the cart, confirm that the lever on the holder completely springs up. If the monitor is not locked, it may fall off.**

Using ZB-900PK/ZS-900PK Transmitter

CAUTION

Heart rate may differ between the monitor and the telemetry system or central monitor due to the difference on the displaying ECG waveform.

Using YL-001P Alarm Pole

CAUTION

- **Firmly connect the alarm pole connector to the alarm pole socket on the monitor. Otherwise, the lamp may not blink and an alarm may not be indicated.**
- **Do not carry the monitor by holding the alarm pole. The alarm pole may detach from the monitor and the monitor may fall off.**

Battery

WARNING

- **Keep the battery pack away from fire. Otherwise the battery pack may explode.**
- **Do not heat the battery pack. The battery pack may explode.**
- **Never short-circuit the + and – terminals on the battery pack with a wire or store the battery pack with metals such as necklace or hair pins. The battery pack may short-circuit, causing the substance inside the battery to leak or explode.**
- **Never disassemble or modify the battery pack. Never damage or directly solder the sheath tube. The battery pack short-circuits, the electrolyte comes out and the battery pack explodes.**
- **Do not subject the battery pack to a strong mechanical shock. The battery may leak or explode.**
- **Do not use a battery which is damaged, such as from falling. There is a gas discharge valve inside the battery and if this valve is damaged, the gas cannot be discharged, causing the battery to explode.**
- **Only use the battery pack on the specified instrument. If the battery is used on an unspecified instrument, large current may flow, causing the battery to explode.**
- **If the battery pack is damaged and the substance inside the battery (alkaline liquid) contacts the eyes or skin, wash immediately and thoroughly with water and see your physician. Never rub your eyes, otherwise you may lose your eyesight.**
- **The battery pack has + and – polarity. Make sure that the battery is installed with the correct polarity direction. Otherwise, the substance inside the battery may leak and explode.**
- **Do not connect the battery pack to an AC outlet or lighter socket in a car. The battery may explode.**
- **Do not immerse the battery pack in water or seawater. The battery will rust and may heat up.**
- **Never use a battery pack which is damaged, discolored or has leakage. A damaged battery may explode if used.**
- **Do not leave the battery for more than two years unused. The battery may leak.**

CAUTION

- **Do not expose the battery pack to direct sunlight or leave in a high temperature place. The lifetime of the battery pack may be shortened or the substance inside the battery pack may leak.**
- **The battery pack must be replaced by qualified service personnel.**
- **Keep the battery pack away from children.**
- **Before disposing of the battery, check with your local solid waste officials for details in your area for recycling options or proper disposal. The battery is recyclable. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream.**

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.
For more information, see the FDA web site.
http://www.fda.gov/cdrh/safety.html

WARNING

- **When using a defibrillator together with the monitor, use Ag/AgCl electrodes. Other types of electrodes, stainless steel in particular, adversely affect the ECG waveform by slowing the baseline recovery on the monitor and result in no monitoring immediately following defibrillation.**
- **False heart rate indicators may occur with certain pacemakers because of electrical overshoots.**
- **Pacemaker patients can only be monitored when the pace program is activated.**
- **Keep pacemaker patients under close observation. The pacemaker rate may be counted during cardiac arrest and certain arrhythmias. Do not rely only on the monitor.**

CAUTION

- **Use only Nihon Kohden products and specified parts and accessories. When other type of electrodes are used, the "CHECK ELECTRODE" message may be displayed and monitoring may stop.**
- **Do not reuse disposable electrodes.**
- **When using the electrodes with DIN type lead, use only the Vitrode V or N electrodes. If other electrodes are used, the electrode lead may not be properly connected and ECG monitoring may be unstable.**
- **If the contact is bad even before the expiration date printed on the package, replace the electrode with a new one.**
- **When the "CHECK ELECTRODE" message is displayed, ECG is not monitored properly. Check the electrode, electrode leads and connection cord, and if necessary, replace it with a new one.**
- **Turn the pacing spike detection to On when monitoring a pacemaker patient. Otherwise QRS and pacemaker spike may not be distinguished and pacemaker failure may not be recognized.**

Respiration Monitoring

WARNING

Interaction Between Minute Ventilation Rate-Adaptive Pacemakers and Cardiac Monitoring and Diagnostic Equipment*

The bioelectric impedance measurement sensor of a minute ventilation rate-adaptive implantable pacemaker may be affected by cardiac monitoring and diagnostic equipment which is connected to the same patient. If this occurs, the pacemaker may pace at its maximum rate and give incorrect data to the monitor or diagnostic equipment. If this occurs, disconnect the monitor or diagnostic equipment from the patient or change the setting on the pacemaker by referring to the pacemaker's manual. For more details, contact your pacemaker distributor or Nihon Kohden distributor.

* Minute ventilation is sensed in rate-adaptive pacemakers by a technology known as bioelectric impedance measurement (BIM). Many medical devices in addition to pacemakers use this technology. When one of these devices is used on a patient with an active, minute ventilation rate-adaptive pacemaker, the pacemaker may erroneously interpret the mixture of BIM signals created in the patient, resulting in an elevated pacing rate.
  For more information, see the FDA web site.
  http://www.fda.gov/cdrh/safety.html

SpO_2 Monitoring

WARNING

- **Measurement may not be correct in the following cases.**
  - **When the oxyhemoglobin or methemoglobin (HbCO, Met Hb) increases abnormally.**
  - **When dye is injected in the blood.**
  - **During CPR.**
  - **When there is body movement.**
  - **When the pulse wave is small.**
- **Check the circulation condition by observing the skin color of the measuring site and pulse waveform. Change the measuring site every 8 hours for disposable probes and every 4 hours for reusable probes. The skin temperature may increase at the attached site by 2 or 3°C (4 or 5°F) and cause a burn or pressure necrosis. When using the probe on the following patients, take extreme care and change the measurement site more frequently according to symptoms and degree.**
  - **A patient with a fever**
  - **A patient with peripheral circulation insufficiency**
  - **Neonate or low birth weight infant with delicate skin**
- **To avoid poor circulation, do not wrap the tape too tight. Check the blood circulation condition by observing the skin color and congestion at the skin peripheral to the probe attachment site. Even for short-term monitoring, there may be burn or pressure necrosis from poor blood circulation, especially on neonates or low birth weight infants whose skin is delicate. Accurate measurement cannot be performed on a site with poor peripheral circulation.**
- **When not monitoring SpO_2, disconnect the SpO_2 connection cord from the bedside monitor. Otherwise, noise from the probe sensor may interfere and incorrect data is displayed on the screen.**
- **Do not use the probe during MRI examination because it may cause skinburn on the probe attachment area. For details, follow the MRI operator's manual.**

CAUTION

- **Turn off the power of cell telephones, small wireless devices and other devices which produce strong electromagnetic interference. Otherwise, the waveforms and measurements are affected by such interference and the displayed data may be incorrect.**
- **Only use the specified probes. Otherwise SpO_2 cannot be monitored properly.**
- **Do not use a disassembled or damaged probe because measured data may be incorrect.**
- **Do not use the probe over its stated lifetime. Otherwise the SpO_2 measurement accuracy cannot be guaranteed.**
- **If the skin gets irritated by the tape, change the attachment site.**
- **Do not attach the probe to the same limb that is used for NIBP measurement or an IBP catheter.**
- **Normally external light does not affect monitoring, however, strong light such as an operating lamp or sunlight may affect monitoring. If affected, cover the measuring site with a blanket.**
- **When attached, make sure that the photo emitter and the detector of the probe face each other. Otherwise, SpO_2 cannot be measured properly.**
- **Do not reuse the disposable probes for another patient.**
- **Disposable probes are not sterilized. To sterilize the probe, refer to the "Sterilizing the Disposable Probe" in Section 12.**
- **When the probe is attached on an appropriate site with sufficient circulation and the error message confirming the probe attachment repeatedly appears, the probe may be deteriorated. Replace it with a new one.**
- **When the probe or SpO_2 connection cord failure message appears on the screen, replace it with a new one. Otherwise SpO_2 data may not be accurate.**
- **When the attachment site is wet with blood or when the patient has nail polish on, remove dirt and nail polish before attaching the probe. The transmitted light may decrease due to blood or nail polish and the measurement data may be incorrect.**
- **To minimize body movement for stable SpO_2 monitoring, fasten the cable with the provided adhesive tape.**
- **Do not pull or bend the probe cable, and do not put caster feet on the probe cable. Do not immerse the probe cable in detergents or water. Failure to follow these cautions may cause cable discontinuity, short circuit, skin burn on the patient and incorrect measurement data. Replace any broken probe with a new one.**
- **When using a disposable probe, be careful when removing the foam tape from neonatal skin.**
- **When removing a disposable probe that is taped to the skin, do not pull the cable part of the probe because this can damage the probe's cable connection.**
- **Refer to the probe instruction manual for details.**

WARNING

- **NIBP measurement on a sickle cell anemia patient may cause a thrombus.**
- **When attaching the cuff to a premature infant at an early stage after birth, periodically change the cuff position to avoid possible skin erosion and fissure.**
- **While performing STAT (continuous) measurements many times without a pause, periodically check the blood vessels and limb for adequate circulation.**
- **When performing long term measurements at intervals less than 2.5 minutes, periodically check the state of the patient, blood vessels and limb for adequate circulation.**

CAUTION

- **Only use the specified cuff. Otherwise NIBP monitoring cannot be performed properly or the monitor may be damaged.**
- **Select the cuff which fits each patient. If the cuff size is not correct, measurement may not be completed or the result may be erroneous due to the different deflation speed of the cuff.**
- **The YP-950T/951T/952T/953T/954T/955T reusable cuffs contain natural rubber latex which may cause allergic reactions.**
- **Do not reuse the disposable cuff.**
- **Disposable cuffs are not sterilized. If necessary, sterilize the cuff using glutaraldehyde solution.**
- **The non-sterilized disposable cuffs for neonates cannot be sterilized. If necessary, use the sterilized disposable cuffs for neonates.**
- **Never sterilize the disposable cuff for neonates.**
- **Do not wrap the cuff on an arm or thigh which is used for injection. NIBP measurement on an arm or thigh which is used for injection may cause reflux of blood and stop injection.**
- **Confirm that the air hoses are firmly connected between the sockets and hoses of the cuff. If not connected properly (the air hose connector clicks and the red color of the NIBP socket is completely hidden behind the air hose connector when properly inserted into the socket), the cuff cannot be correctly identified and air leakage will cause incorrect NIBP data or no data.**
- **When too much pressure is applied to the cuff, or the hose is folded or kinked, the "NIBP SAFETY VALVE OPEN" message appears on the screen and NIBP monitoring may be stopped. Remove the cause, wait for 40 seconds, check that the message disappears, then measure again.**
- **If the hose is folded or squeezed, it will cause incorrect NIBP data due to the air pressure noise.**
- **Do not rely only on the PWTT to monitor blood pressure changes. When it is necessary to monitor critical blood pressure change, set the appropriate interval for NIBP measurement.**

- **When the delta PWTT threshold is too short for a patient, NIBP measurement may be performed too frequently. If this occurs, change the delta PWTT threshold to a longer time.**
- **The PWTT may be incorrect when there is too much arrhythmia or noise.**
- **In the following cases, PWTT may trigger too many or no NIBP measurements. Check the patient condition. If necessary, change the delta PWTT threshold or set PWTT to Off.**
  - **Rapid blood pressure change with vasoreflex due to vasoactive drugs, such as phenylephrine and nicardipine.**
  - **Unstable pulse wave due to poor peripheral circulation.**
  - **Too many arrhythmias.**
  - **Patient movement.**
  - **Noise on ECG.**
  - **SpO_2 measurement on foot of a child.**
- **Do not measure NIBP with PWTT on a neonate because circulation of a neonate changes rapidly.**

Maintenance

CAUTION

- **Do not disassemble the monitor. Disassembly must be performed by a qualified service personnel.**
- **Fuses must be replaced by a qualified service personnel.**
- **Do not use volatile liquids such as thinner or benzine, because these will cause the materials to melt or crack.**
- **Before cleaning the monitor, turn the monitor power off and disconnect the power cord from the AC SOURCE power cord socket on the right side panel.**
- **After cleaning, make sure that the monitor is completely dried.**
- **Wipe the monitor thoroughly after disinfecting it with spray.**
- **The bedside monitor is not waterproof. Be careful not to let any water get inside the monitor.**
- **Never sterilize the monitor because the materials may deform, crack or discolor.**

Specifications

Display

Display size:	5.6 inch, TFT type color LCD
Waveform display mode:	Non-fade moving
Viewing area:	114.2 mm × 83.5 mm
Maximum number of waveform trace:	2 traces
Sweep speed:	25 mm/s, respiration waveform 6.25 mm/s
Sweep time:	about 79 mm (at 25 mm/s sweep speed)
Display waveforms:	ECG, respiration, SpO_2 pulse wave
Numerical data display:	Heart rate/pulse rate, respiration rate, NIBP (systolic, diastolic, mean), SpO_2, NIBP measurement time, NIBP measurement mode and current time

Alarm

Alarm items:	Upper/lower limits alarm, apnea alarm, connector disconnection alarm, NOISE alarm, electrode off alarm, pulse waveform detecting alarm, probe off alarm, cuff/hose check alarm, battery weak alarm, operating environment alarm
Alarm suspend:	Provided for 2 min

ECG

Heart rate counting range:	0, 12 to 300 beats/min
Pacemaker pulse rejection capability:	0.1 to 2.0 ms, ±2 to 700 mV
Defibrillation-proof:	ECG input protected against 400 J
Electrode offset potential tolerance:	±500 mV
Input dynamic range:	± 5 mV
Input impedance:	≥5 MΩ (at 10 Hz)
Frequency response:	0.5 to 20 Hz 50 or 60 Hz
Lead:	I, II, III
Waveform display:	
Display sensitivity:	10 mm/mV ±5% (at ×1 sensitivity)
Sensitivity control:	×1/4, ×1/2, ×1, ×2, ×4, or AUTO
Pacing spike display:	Available
Alarm items:	
Upper limit range:	20 to 300 beats/min in 5 beats/min steps, OFF
Lower limit range:	OFF, 15 to 295 beats/min in 5 beats/min steps

Respiration (Transthoracic impedance pneumography)

Respiration counter counting range:	0 to 150 breaths/min
Waveform display:	
Display sensitivity:	10 mm/Ω
Sensitivity control:	×1/4, ×1/2, ×1, ×2, ×4
Alarm:	
Upper limit range:	2 to 150 breaths/min in 2 breaths/min steps, OFF
Lower limit range:	OFF, 0 to 148 breaths/min in 2 steps
Apnea time:	OFF, 5 to 40 s in 5 s steps

SpO_2

Measuring range:	0 to 100%
Pulse rate counting range:	30 to 300 beats/min
SpO_2 accuracy:	Monitor only: ±1 digits (80% ≤ SpO_2 ≤ 100%), ±2 digits (50% ≤ SpO_2 < 80%)
	With probe: ±2 digits (80% ≤ SpO_2 ≤ 100%), ±3 digits (70% ≤ SpO_2 < 80%)
Waveform sensitivity:	×1/8, ×1/4, ×1/2, ×1, ×2, ×4, ×8 or AUTO
Alarm:	
Upper limit range:	51 to 100% SpO_2 in 1% SpO_2 steps, OFF
Lower limit range:	OFF, 50 to 99% SpO_2 in 1% SpO_2 steps

Non Invasive Blood pressure, NIBP

Measuring range:	0 to 300 mmHg
Accuracy:	±3 mmHg (0 mmHg ≤ NIBP < 200 mmHg)
	±4 mmHg (200 mmHg ≤ NIBP ≤ 300 mmHg)
Safety:	
Cuff inflation maximum pressure:	Adult 300 to 330 mmHg
	Neonate 150 to 165 mmHg
Cuff inflation time limiter:	Adult ≤180 s
	Neonates ≤90 s
Measurement mode:	Manual
	STAT (continuous)
	Automatic (periodic), PWTT
Alarm:	
Upper limit range:	15 to 260 mmHg in 5 mmHg steps, OFF
Lower limit range:	OFF, 10 to 255 mmHg in 5 mmHg steps

Trendgraph

Trend parameters:	NIBP (systolic, diastolic and mean), heart rate/pulse rate, SpO_2, respiration rate
Trend display width:	30 min, 1, 2, 4, 8, or 24 h

Vital Signs List

Parameters:	Listed time, NIBP (systolic, diastolic and mean), heart rate (or pulse rate), SpO_2, respiration rate
Maximum number of files in list:	400

Recording (optional, RG-101W)

Recording method:	Thermal array recording
Recording width:	≥48 mm
Paper speed:	25, 12.5, 6.25 mm/s
Recording sensitivity:	10 mm/mV (at SENS × 1)

Power Requirement

Line voltage:	AC 100 to 240 V ± 10%
Line frequency:	50 or 60 Hz
Battery pack (NKB-302):	DC 9.6 V
Power consumption:	AC: 85 VA maximum
	DC: 40 W maximum

Environment

Operating environment

Temperature:	10 to 40°C
Humidity:	30 to 85% RH (non-condensing)
Atmospheric pressure:	70 to 106 kPa

Storage environment

Temperature:	–20 to +65°C
	–15 to +55°C (Recording paper)
Humidity:	10 to 95% RH (non-condensing)
Atmospheric pressure:	70 to 106 kPa

Dimensions and Weight (approximate)

Dimensions:	195 mm W × 205 mm H ×185 mm D
Weight:	4.0 kg (excluding options)

Electromagnetic Compatibility

IEC60601-1-2 (1993) – Collateral Standard: Electromagnetic compatibility – Requirement and tests

Emissions:	CISPR11 Group 1, Class B

Safety Standard

Safety standard:	IEC 60601-1 (1988) Amendment 1 (1991), Amendment 2 (1995)
	IEC 60601-1-1 Amendment 1 (1995)
	IEC 60601-2-27 (1994) - Particular requirements for the safety of electrocardiographic monitoring
	IEC 60601-2-30 (1995) - Particular requirements for the safety of automatic cycling in in-direct blood pressure monitoring equipment

According to the type of protection against electrical shock:

CLASS I EQUIPMENT (AC Powered)

Internally Powered EQUIPMENT (BATTERY Powered)

According to the degree of protection against electrical shock

ECG, Respiration (impedance):	Defibrillator-proof type CF applied part
SpO_2, NIBP:	Defibrillator-proof type BF applied part

According to the degree of protection against harmful ingress of water:

IPX0 (ordinary EQUIPMENT)

According to the degree of safety of application in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE:

Equipment not suitable for use in the presence of FLAMMABLE ANAESTHETIC MIXTURE WITH AIR, OR WITH OXYGEN OR NITROUS OXIDE

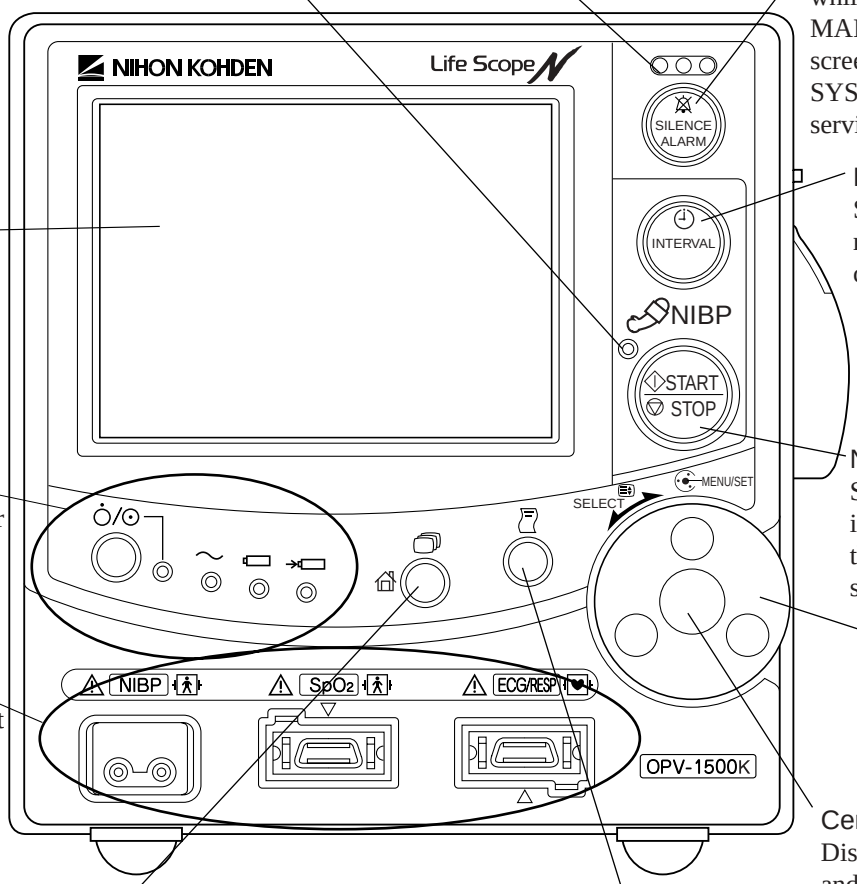
According to the mode of operation: CONTINUOUS OPERATION

Clock Accuracy

At operating temperature 25°C: about ±3 min/month maximum
At storage temperature –20 to 65°C: about ±5 min/month maximum

Panel Description

Front Panel



Alarm indicator
Red or orange lamp blinks or lights according to the alarm settings.

NIBP lamp
Lights during NIBP measurement.

SILENCE ALARM key
Silences the alarm sound.
When the power key is pressed while this key is pressed, the MAINTENANCE MODE screen is displayed for the SYSTEM SETUP settings and servicing.

NIBP INTERVAL key
Selects NIBP measurement mode. Pressing this key changes the mode.

Screen
Displays monitoring data.

NIBP START/STOP key
Starts NIBP measurement in selected mode. Pressing this key during measurement stops measurement.

Power panel
Refer to the "Power Panel" section.

Rotary dial
Selects item on the setup windows.
Scrolls data on the review windows.

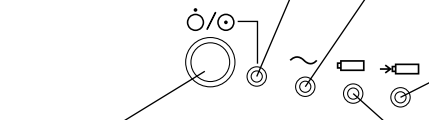
Socket panel
Refer to the "Socket Panel" section.

Center key
Displays the setup windows and registers the setting.

Screen select key
Changes the screen in the following order:
Monitoring screen, list window, trend window, sleep mode screen.
Displays monitoring screen when pressed on the setup window.

Record key
Press to start or stop recording.

Power Panel



Power lamp
Lights when the monitor is turned on.

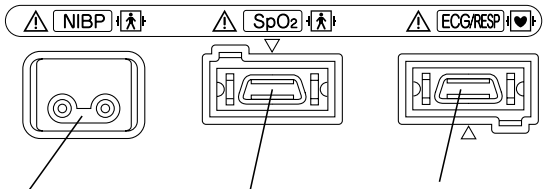
AC power lamp
Lights when the power cord is connected between the AC SOURCE socket and AC outlet.

Battery charging lamp
Indicates the battery status.
Lit: Fully charged
Blinking: Being charged

Power key
Press and hold for more than one second to turn the monitor on or off.

Battery power lamp
Lights when operating on battery power.

Socket Panel

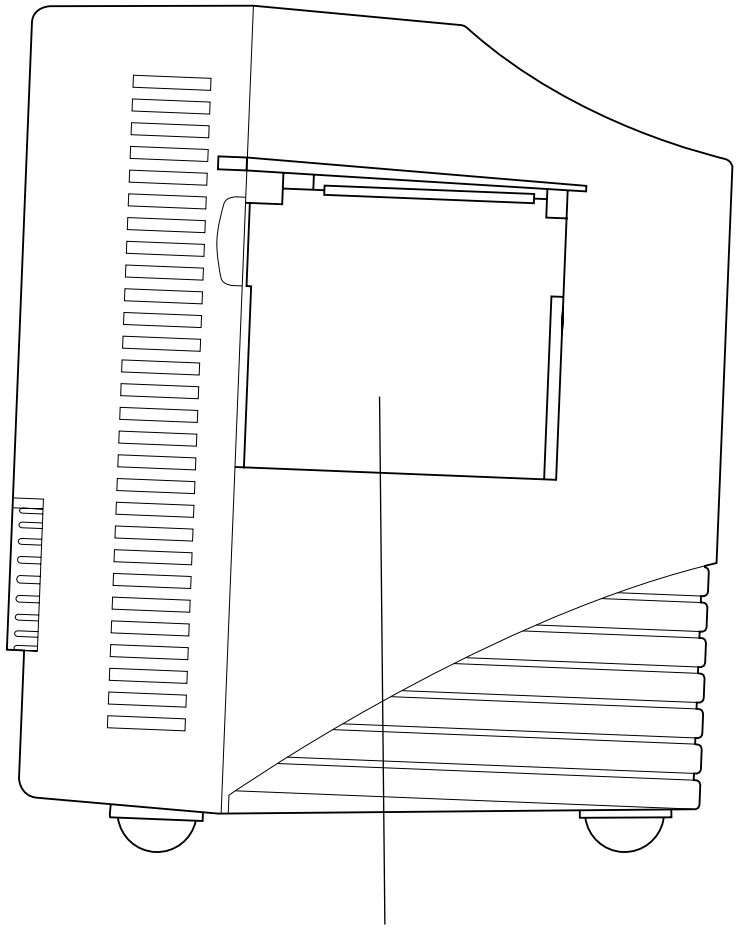


NIBP socket
Connects to the air hose.

ECG/RESP socket
Connects to the ECG connection cord.

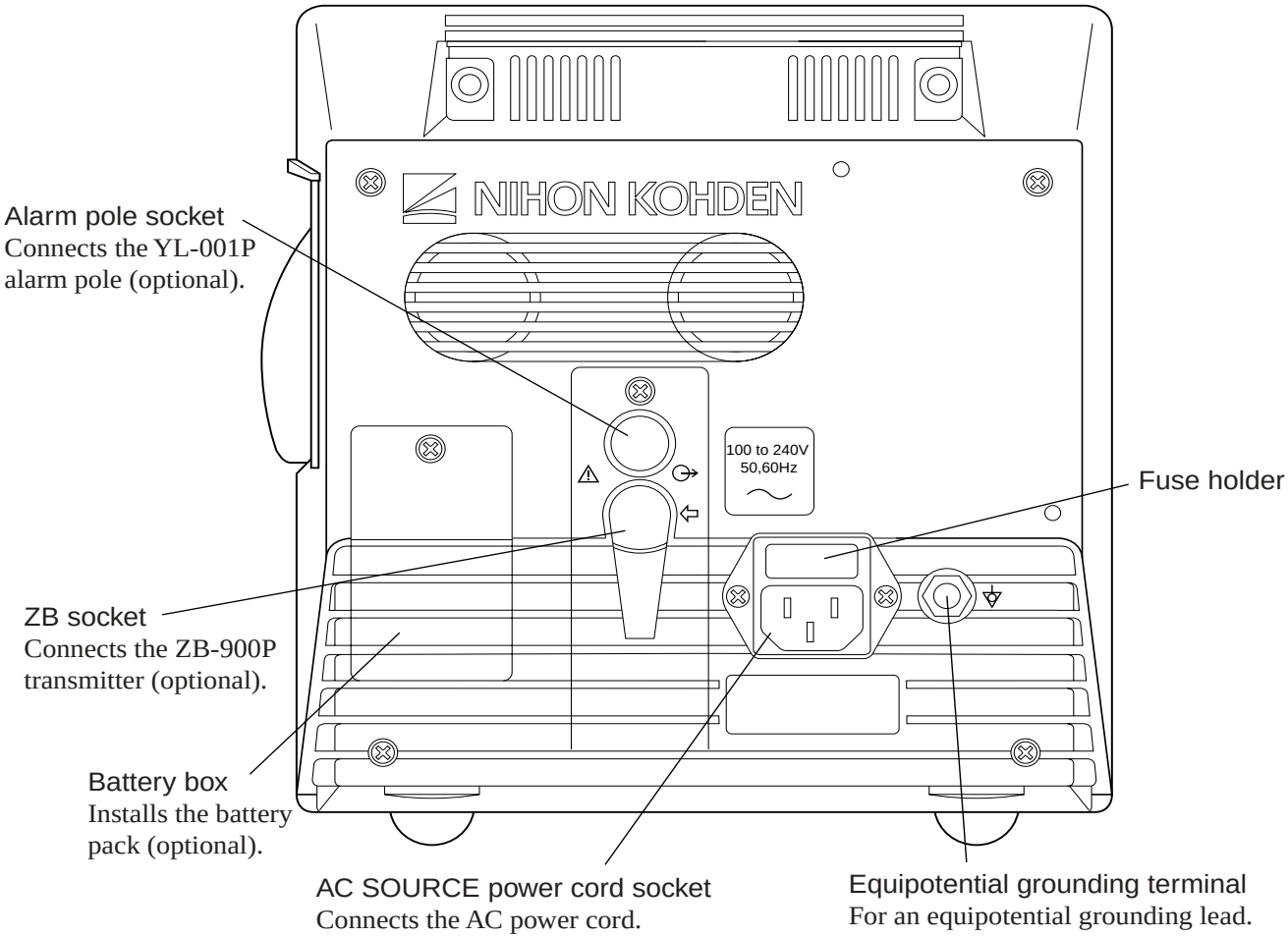
SpO_2 socket
Connects to the SpO_2 connection cord.

Right Side Panel

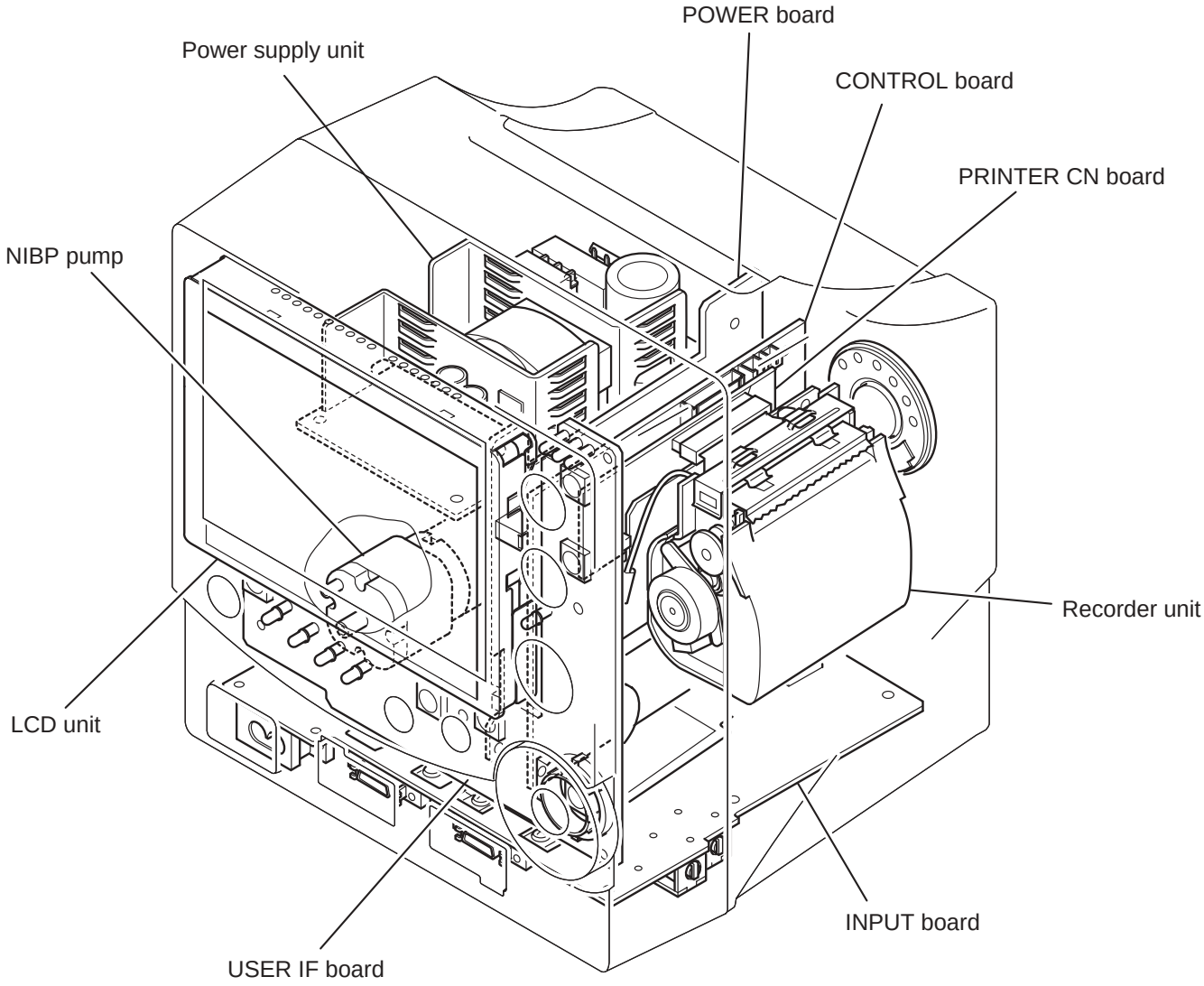


RG-101W recorder unit (option)

Rear Panel

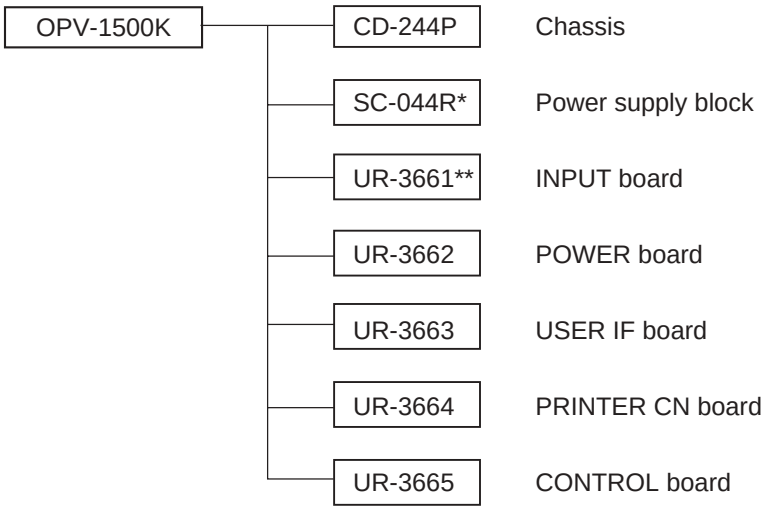

NIHON KOHDEN
100 to 240V
50,60Hz
Alarm pole socket
Connects the YL-001P alarm pole (optional).
Fuse holder
ZB socket
Connects the ZB-900P transmitter (optional).
Battery box
Installs the battery pack (optional).
AC SOURCE power cord socket
Connects the AC power cord.
Equipotential grounding terminal
For an equipotential grounding lead.

Board / Unit Location View



Composition

Standard Components

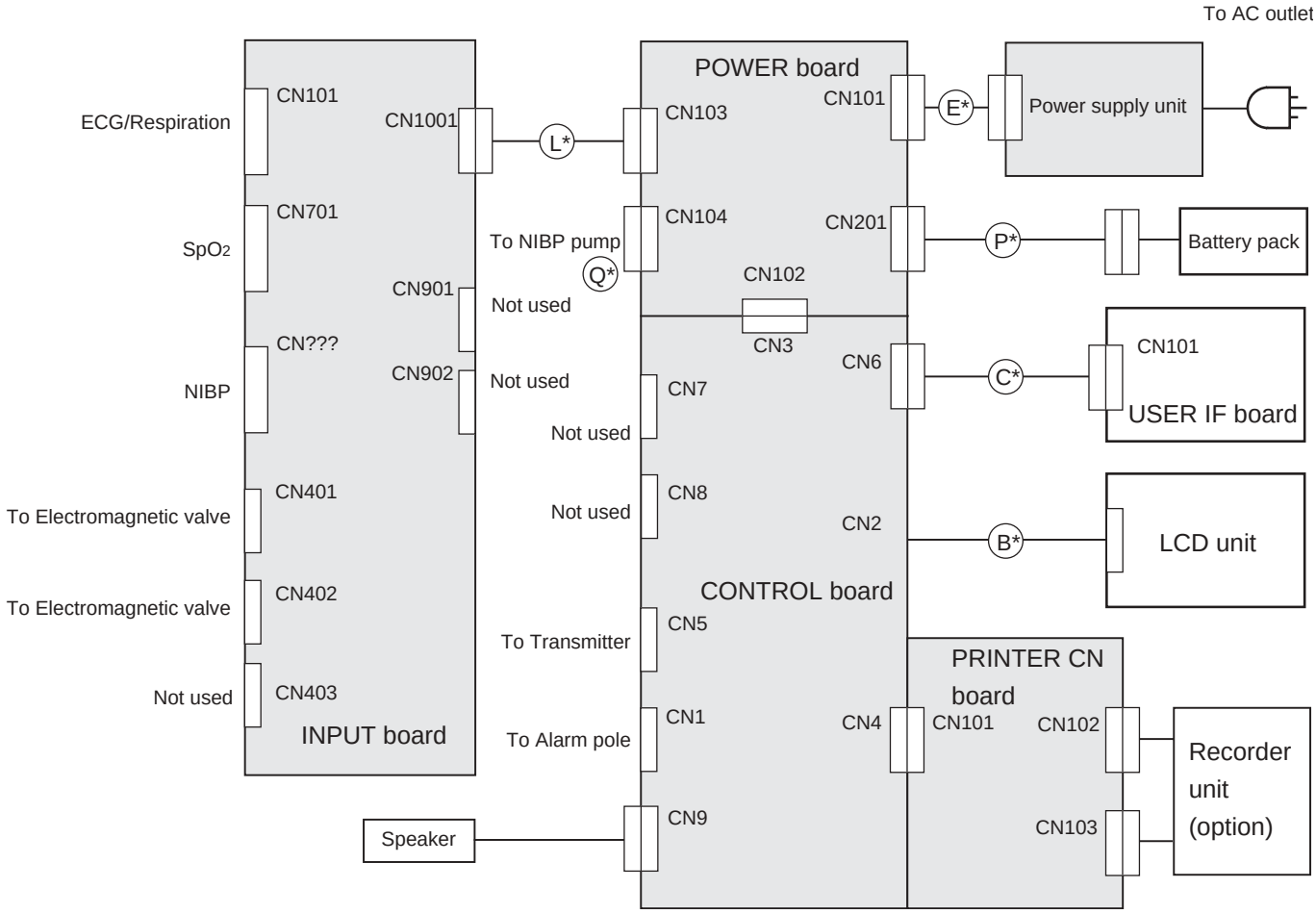


* / ** Refer to Section 7 Replaceable Parts List.

Options

RG-101W	Recorder unit
YL-001P	Alarm pole
ZB-900PK	Transmitter
ZS-900PK	Transmitter
KC-012P	Cart
NKB-302	Battery pack

Cable Connections



* About wire harnesses B, C, E, L, P and Q, refer to Section 7 Replaceable Parts List.

Section 2 Troubleshooting

General 2.1

Instrument Problems 2.2

Vital Sign Problems 2.4
- ECG 2.4
- Respiration 2.6
- SpO_2 ..... 2.7
- NIBP 2.9

General

Use the troubleshooting tables to locate, identify, and solve a problem in the instrument. The problems are divided into general problem areas. Each category has its own troubleshooting table for fast and easy troubleshooting.

• Instrument Problems

• Vital Sign Problems
  • ECG
  • Respiration
  • SpO_2
  • NIBP

If these sections do not solve the problem, contact your Nihon Kohden representative.

NOTE

Before contacting your Nihon Kohden representative for technical support, please provide additional detailed information on the problem. This will allow your Nihon Kohden representative to provide your with the best support.

How to use the troubleshooting table

1. Determine which troubleshooting table to use.

2. In the “Problem” or “Screen Message” column, find the trouble item that matches the problem.

3. Do the action recommended in the “Action” column.

4. If the problem is not solved, do the action for the next possible cause of criteria.

5. If none of the actions solve the problem, contact your Nihon Kohden representative.

Instrument Problems

Problem	Possible Cause/Criteria			Action
The monitoring screen does not appear when you turn on the instrument in AC operation.	The AC power lamp on the front panel is not lit.	The line voltage is unstable or not output.		Contact the facility manager.
		The power cord has a failure.		Replace the power cord with a new one.
		The AC inlet fuse is blown.		Remove the cause of the blown fuse, then replace the fuse with a new one.
		The AC inlet socket - power supply unit wire harness has a failure.		Replace the wire harness with a new one.
		The power supply unit has a failure.		Replace the unit with a new one.
		The POWER board has a failure. The CONTROL board has a failure. The USER IF board has a failure.		Replace the board with a new one.
	The AC power lamp on the front panel is lit.	The power supply unit - POWER board wire harness has a failure.		Replace the wire harness with a new one.
		The POWER board has a failure. The CONTROL board has a failure. The USER IF board has a failure.		Replace the board with a new one.
		The USER IF board - CONTROL board wire harness has a failure.		Replace the wire harness with a new one.
		The power supply unit has a failure.		Replace the unit with a new one.
The monitoring screen does not appear when you turn on the instrument in battery operation.	Connect the power cord (plugged into an AC outlet) to the instrument, then turn on the instrument and wait a few minutes.	The battery power and battery charging lamps are rapidly blinking or off.	The battery has a failure.	Replace the battery with a new one.
			The POWER board - battery terminal wire harness has a failure.	Replace the wire harness with a new one.
			The POWER board has a failure.	Replace the board with a new one.
		The battery charging lamp is slowly blinking.	The battery is fully discharged.	Charge the battery under this condition and check the battery operation after the battery is fully charged.
			The POWER board has a failure.	Replace the board with a new one.
		The battery charging lamp is lit.	The POWER board has a failure.	Replace the board with a new one.
Battery operation time is shorter than the specification.	The battery has been used for one year or more.	The battery lifetime has gone.		Replace the battery with a new one.
		The POWER board has a failure.		Replace the board with a new one.
	The battery has been used for less than one year.	The POWER board has a failure.		Replace the board with a new one.
No sound	The speaker has a failure.			Replace the speaker with a new one.
	The CONTROL board has a failure.			Replace the board with a new one.
No key operation	The USER IF board - CONTROL board wire harness has a failure.			Replace the wire harness with a new one.
	The USER IF board has a failure. The CONTROL board has a failure.			Replace the board with a new one.
No display	The LCD unit has a failure.			Replace the unit with a new one.
	The LCD unit - CONTROL board wire harness has a failure.			Replace the wire harness with a new one.

The display is dim or waveform(s) and/or characters are distorted.	The LCD unit - CONTRO board wire harness has a failure.		Replace the wire harness with a new one.
	The CONTROL board has a failure.		Replace the board with a new one.
Some pixels on the screen do not light or have abnormal color.	9 pixels or less on the screen do not light or have abnormal color.	The LCD unit is normal.	The LCD unit replacement is not required.
	More than 9 pixels on the screen do not light or have abnormal color.	The LCD unit is faulty.	Replace the LCD unit with a new one.
The screen changes to Error screen.	The POWER board - INPUT board wire harness has a failure.		Replace the wire harness with a new one.
	The INPUT board has a failure.		Replace the board with a new one.
The optional recorder unit built in the instrument does not record the waveform and numeric data on the paper.	The waveform and numeric data are displayed on the screen.	The recorder unit has a failure.	Replace the recorder unit with a new one.
		The CONTROL board has a failure. The POWER board has a failure. The PRINTER CN board has a failure.	Replace the board with a new one.
	The waveform and numeric data are not displayed on the screen.	The CONTROL board - USER IF board wire harness has a failure.	Replace the wire harness with a new one.
		The USER IF board has a failure. The CONTROL board has a failure.	Replace the board with a new one.
The recorded data such as waveform and grid has a faint part on the paper or there are missing dots on the recorded data.	Check that the specified recording paper is used.		Use the specified paper if not used.
	Clean the thermal array head of the recorder unit.		Replace the thermal array head with a new one.
	The recorder unit has a failure.		Replace the unit with a new one.
	The CONTROL board has a failure. The PRINTER CN board has a failure. The POWER board has a failure.		Replace the board with a new one.
Straight line is recorded at the same position on the paper.	The recorder unit has a failure.		Replace the unit with a new one.
	The CONTROL board has a failure. The PRINTER CN board has a failure.		Replace the board with a new one.
There is unevenness on the paper.	The recorder unit has a failure.		Replace the unit with a new one.
	The CONTROL board has a failure. The PRINTER CN board has a failure.		Replace the board with a new one.
The paper speed is unstable and waveform is compressed or extended on time scale.	The recorder unit has a failure.		Replace the unit with a new one.
	The CONTROL board has a failure. The PRINTER CN board has a failure.		Replace the board with a new one.

Vital Sign Problems

ECG

Screen Message	Possible Cause/Criteria	Action
ECG CONNECTOR OFF	The ECG connection cord is not firmly connected to the instrument.	Firmly connect the ECG connection cord to the instrument.
	One of the following has something wrong or a failure. - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
ECG NOISE	EMG noise is superimposed.	Change the electrode position to where there is less muscle.
	The baseline is not stable due to respiration or body movement.	Change the electrode position.
	The electrode is pulled by the lead.	Put some slack into the electrode lead.
	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
CHECK ELECTRODE	The ECG connection cord is not firmly connected to the instrument.	Firmly connect the ECG connection cord to the instrument.
	The ECG connection cord is not firmly connected to the electrode lead	Firmly connect the ECG connection cord to the electrode lead.
	There is a poor contact between the electrode lead and electrode.	Clean the electrode lead clip and firmly connect it to the electrode.
	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
Pacing pulses are indicated on the screen. (When PACING DETECT is set to ON on the ECG ETC window.)	Pacing spike is detected.	When the patient does not have an implanted cardiac pacemaker, set the PACING DETECT to OFF on the ECG ETC window.
	An electric blanket is used.	Use another warming method or cover the electric blanket with a shield sheet.
	ECG of a neonate is monitored.	Set the PACING DETECT to OFF on the ECG ETC window.
	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.

Problem	Possible Cause/Criteria	Action
The heart rate is inaccurate.	The QRS amplitude is less than 5 mm.	Change the sensitivity or ECG lead so that the QRS amplitude is 5 mm or more.
	The patient has no implanted cardiac pacemaker but narrow QRS width such as neonatal ECG.	Set the PACING DETECT to OFF on the ECG ETC window.
	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
AC interference on the ECG waveform	An electric blanket is used.	Use another warming method or cover the electric blanket with a shield sheet.
	The AC outlet connected to the noise source is used for the instrument.	Use a different AC outlet which is not connected to the noise source.
	The ground facility is poor.	Check the ground facility.
	AC LINE NOISE FILTER on the SYSTEM SETUP screen is set to OFF.	Set AC LINE NOISE FILTER to ON.
	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
Large baseline wandering	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.

Respiration

Screen Message	Possible Cause/Criteria	Action
RESP OFF	Respiration monitoring is set to OFF.	Set the RESP SENS to one of the settings on the ECG ETC window when the respiration monitoring is necessary.
RESP NOISE	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
CHECK ELECTRODE	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
APNEA	The respiration waveform is displayed and has a small peak and valley.	Increase the sensitivity by setting the RESP SENS on the ECG ETC window.
	If the respiration waveform is flat at the maximum sensitivity, one of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.

Problem	Possible Cause/Criteria	Action
The respiration rate is not counted.	The respiration waveform is displayed and has a small peak and valley.	Increase the sensitivity by setting the RESP SENS on the ECG ETC window.
	If the respiration waveform is flat at the maximum sensitivity, one of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
The respiration waveform and respiration rate are not stable.	The electrode positions are not appropriate to monitor the respiration.	Check the electrode positions for respiration measurement.
	One of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
The respiration rate is inaccurate.	The respiration waveform is stable.	Increase the sensitivity by setting the RESP SENS on the ECG ETC window.
	If the respiration waveform is unstable, one of the following has something wrong or a failure. - Electrode - Electrode lead - ECG connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.

SpO_2

Screen Message	Possible Cause/Criteria	Action
Body movement mark M	The probe is not properly attached to the patient.	Attach the probe to the patient properly.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 LIGHT INTERFERECE	A surgical light, bilirubin lamp, or sunlight is close to the probe.	Cover the probe attachment site with a blanket.
	The probe is not properly attached to the patient.	Attach the probe to the patient properly.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 CONNECTOR OFF	The SpO_2 connection cord is not firmly connected to the instrument.	Firmly connect the SpO_2 connection cord to the instrument.
	One of the following has something wrong or a failure. - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 CHECK PROBE SITE	The probe is not attached to the appropriate site of the patient.	Attach the probe to a site 6 to 14 mm thick.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 CHECK PROBE	The probe is not properly attached to the patient.	Attach the probe to the patient properly.
	The probe is not firmly connected to the SpO_2 connection cord	Firmly connect the probe to the SpO_2 connection cord.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 PROBE FAULT	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 WEAK PULSE	The probe is attached too tightly and is obstructing the blood circulation.	Reattach the probe to the patient.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 SEARCHING PULSE	The probe is not attached to the appropriate site of the patient.	Attach the probe to a site 6 to 14 mm thick.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 CANNOT DETECT PULSE	The probe is not properly attached to the patient.	Attach the probe to the patient properly.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SpO_2 MODULE FAILURE	The INPUT board has something wrong or a failure.	If the board has a failure, replace it with a new one.

Problem	Possible Cause/Criteria	Action
Unstable SpO2 value	The probe size is inappropriate.	Use the correct size probe.
	The probe is attached to the same limb that is used for NIBP or IBP measurement.	Attach the probe to the other limb.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
There is a poor correlation between the SpO_2 value on the instrument and SaO_2 value on a blood gas analyzer.	The probe is not properly attached to the patient.	Attach the probe properly. (The emitter and detector of the probe must face each other.)
	The probe size is inappropriate.	Use the correct size probe.
	The probe attachment site is dirty.	Clean the site. Remove nail polish if necessary.
	One of the following has something wrong or a failure. - Probe - SpO_2 connection cord - INPUT board	Check them. If one of them has a failure, replace it with a new one.
Sine wave noise on the pulse wave	Light interference.	Cover the probe attachment site with a blanket.
	The line frequency setting on the instrument is not correct.	Set the correct line frequency on the SYSTEM SETUP screen.

NIBP

Screen Message	Possible Cause/Criteria	Action
NIBP SAFETY VALVE OPEN (When this message is displayed, measurement cannot be performed for 40 seconds.)	The cuff or air hose is bent or squeezed.	Remove the cause.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tubes in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
NIBP RE-MEASURING (Remeasurement is automatically performed. If the message still appears, after remeasurement, do the counter actions.)	Since the patient has arrhythmia, body movement or shivering, the measurement is stopped by the safety circuit.	Wait for 40 seconds before remeasurement.
	The cuff or air hose is bent or squeezed.	Remove the cause.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tubes in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
NIBP ZEROING	If this message does not disappear from the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tubes in the instrument - INPUT board	Check them. If one of them has a failure, replace it with a new one.
NIBP CHECK INTERVAL	The 1-minute interval NIBP measurement is done for 30 minutes or more.	Normal operation. Check the patient whether the measurement conditon should be changed or not.
	The INPUT board has something wrong or a failure if this message frequently appears on the screen.	If the board has a failure, replace it with a new one.
NIBP NOISE	The patient has arrhythmia.	Use the stethoscope method or palpation method if possible.
	The patient has body movement or shivering.	Check the patient and remove the cause or use the stethoscope method or palpation method if possible.
	The cuff or air hose is bent or squeezed.	Remove the cause.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tube in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
NIBP HARDWARE ERROR	The INPUT board has a failure.	Replace the board with a new one.
NIBP WEAK PULSE	The cuff is loosely wrapped around the upper arm or cuff size is not appropriate.	Tightly wrap the cuff around the upper arm. If the cuff size is not appropriate, use an appropriate one.

	If this message frequently appears on the screen, one of the following has something wrong or a failure. - - Cuff - Air hose - Air tube in the instrument - INPUT board	
NIBP NO PULSE	The patient has a shock or arrhythmia.	Use the stethoscope method or palpation method if possible.
	The patient has body movement or shivering.	Check the patient and remove the cause or use the stethoscope method or palpation method if possible.
	The cuff or air hose is bent or squeezed.	Remove the cause.
	The cuff is loosely wrapped around the upper arm.	Tightly wrap the cuff around the upper arm.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tube in the instrument - INPUT board	Check them. If one of them has a failure, replace it with a new one.
AIR HOSE OFF	The connection between the air hose and instrument is incomplete.	Disconnect the air hose from the instrument and connect the air hose to the instrument again.
	The connection between the air hose and cuff is incomplete.	Disconnect the air hose from the cuff and connect the air hose to the cuff again.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tubes in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
INFLATION PRESS LOW	The connection between the air hose and instrument is incomplete.	Disconnect the air hose from the instrument and connect the air hose to the instrument again.
	The connection between the air hose and cuff is incomplete.	Disconnect the air hose from the cuff and connect the air hose to the cuff again.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tubes in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
HIGH CUFF PRESS	The cuff or air hose is bent or squeezed.	Remove the cause.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tubes in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
CUFF OCCLUSION	The cuff or air hose is bent or squeezed.	Remove the cause.

CUFF OCCLUSION	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tubes in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
AIR LEAK	The connection between the air hose and instrument is incomplete.	Disconnect the air hose from the instrument and connect the air hose to the instrument again.
	The connection between the air hose and cuff is incomplete.	Disconnect the air hose from the cuff and connect the air hose to the cuff again.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tubes in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
SYSTOLIC OVER	The patient has arrhythmia.	Use the stethoscope method or palpation method if possible.
	The patient has body movement or shivering.	Check the patient and remove the cause or use the stethoscope method or palpation method if possible.
	The cuff or air hose is bent or squeezed.	Remove the cause.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tube in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
NIBP MEAS TIME-OUT	The patient has arrhythmia.	Use the stethoscope method or palpation method if possible.
	The patient has body movement or shivering.	Check the patient and remove the cause or use the stethoscope method or palpation method if possible.
	The cuff or air hose is bent or squeezed.	Remove the cause.
	If this message frequently appears on the screen, one of the following has something wrong or a failure. - Cuff - Air hose - Air tube in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.

Problem	Possible Cause/Criteria	Action
Cuff inflation pressure is less than 10 mmHg.	One of the following has something wrong or a failure. - Cuff - Air hose - Air tube in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
The cuff does not inflate but the cuff pressure on the screen rapidly increases.	One of the following has something wrong or a failure. - Cuff - Air hose - Air tube in the instrument - INPUT board	Check them. If one of them has a failure, replace it with a new one.
Cannot measure NIBP.	One of the following has something wrong or a failure. - Cuff - Air hose - Air tube in the instrument - NIBP pump - Valves - INPUT board	Check them. If one of them has a failure, replace it with a new one.
The NIBP data is quite different from the stethoscope NIBP measurement.	The patient has a shock or arrhythmia.	Use the stethoscope method or palpation method if possible.
	The patient has body movement or shivering.	Check the patient and remove the cause or use the stethscope method or palpation method if possible.
	The cuff or air hose is bent or squeezed.	Remove the cause.
	The cuff is loosely wrapped around the upper arm.	Tightly wrap the cuff around the upper arm.
	The INPUT board has something wrong or a failure if this problem frequently occurs.	If the board has a failure, replace it with a new one.
Auto measurement does not start even when the time interval has passed.	The INPUT board has something wrong or a failure.	If the board has a failure, replace it with a new one.
Buzz sounds when the NIBP START/STOP key is pressed and cannot measure NIBP.	The cuff pressure does not decrease below the specified pressure level or the NIBP measurement starts during the pause.	Normal operation. When the cuff pressure decreases below the specified level after the previous NIBP measurement, press the NIBP START/STOP key for the next measurement.
	The INPUT board has something wrong or a failure if this problem frequently occurs.	If the board has a failure, replace it with a new one.

Section 3 Diagnostic Check

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Introduction

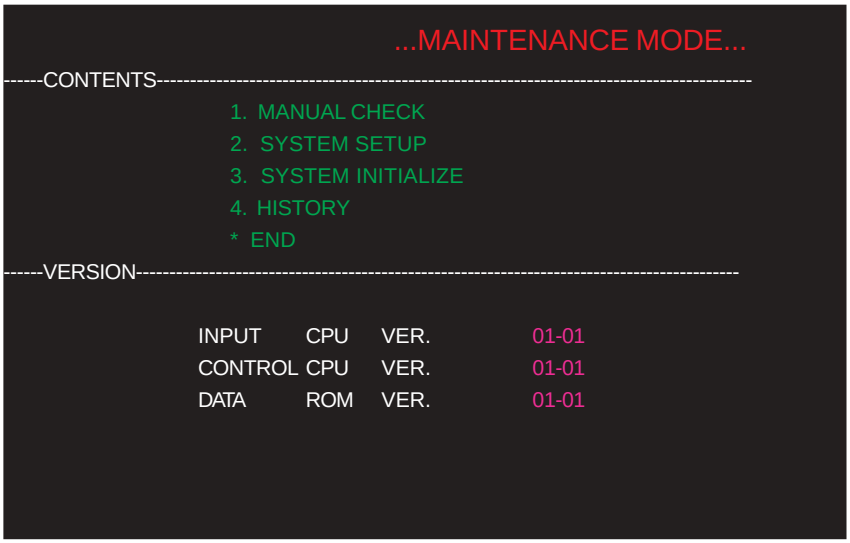
The instrument has a check program which manually diagnoses the instrument. This check program can be executed at any time.

All errors detected at any time in monitor mode are stored in an error history table that you can view.

The manual check, system setup, system initialization and error history are accessed from the MAINTENANCE MODE screen.

Calling Up the MAINTENANCE MODE Screen

1. Press the power key on the front panel while pressing the SILENCE ALARM key on the front panel. The MAINTENANCE MODE screen appears as shown below. “1. MANUAL CHECK” is selected.



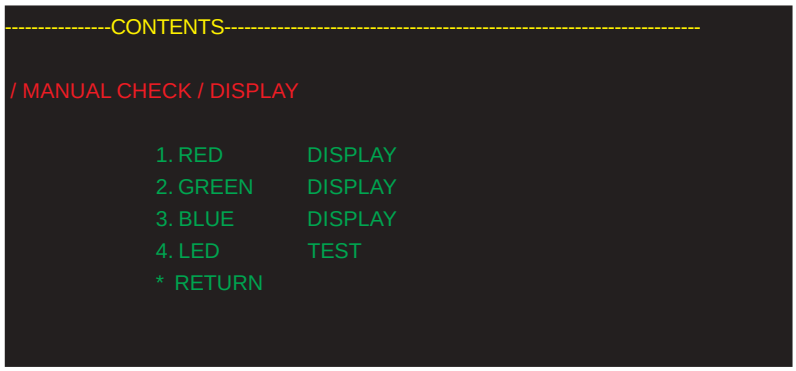
2. Press the rotary dial center key on the front panel. The MANUAL CHECK screen appears.

3. Turn the rotary dial to select one of the checks and press the rotary dial center key to perform the selected check.

- Display check
- Sound check
- Memory check
- Key check
- Optional transmitter check
- Optional recorder check
- NIBP check
- ECG and impedance method respiration checks
- SpO2 check

Display Check

1. Turn the rotary dial to select “DISPLAY” on the MANUAL CHECK screen and press the rotary dial center key. The following screen appears.



1. RED DISPLAY: Displays the whole screen in red.
2. GREEN DISPLAY: Displays the whole screen in green.
3. BLUE DISPLAY: Displays the whole screen in blue.
4. LED TEST: Lights the alarm indicator and NIBP lamp.

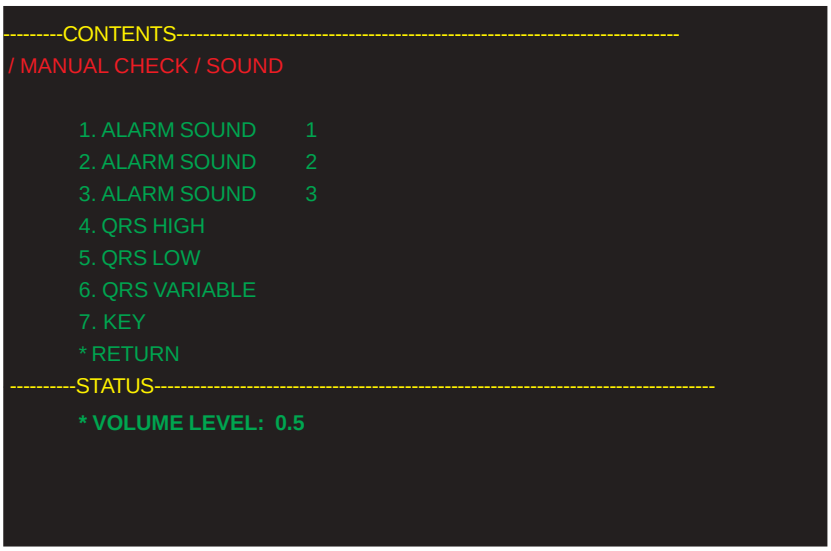
2. Turn the rotary dial to select a test on the screen and press the rotary dial center key to perform the test.

3. Check that the above four test results are normal. Note that the LCD is normal even if up to 9 pixels on the screen do not light or have abnormal color.

4. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Sound Check

1. Turn the rotary dial to select “SOUND” on the MANUAL CHECK screen and press the rotary dial center key. The following screen appears.



1. ALARM SOUND1: Generates the alarm type 1 (continuous sound) sound.
2. ALARM SOUND2: Generates the alarm type 2 (single sound at every 20 seconds) sound.
3. ALARM SOUND3: Generates the alarm type 3 (single sound only) sound.
4. QRS HIGH: Generates the high pitch QRS synchronization sound.
5. QRS LOW: Generates the low pitch QRS synchronization sound.
6. QRS VARIABLE: Generates the variable pitch QRS synchronization sound.
7. KEY: Generates the key click sound.

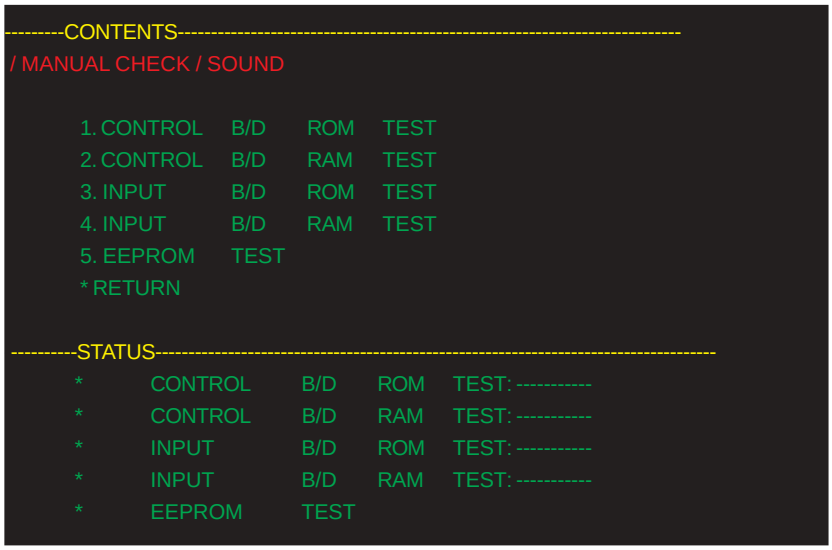
2. Turn the rotary dial to select a test on the screen and press the rotary dial center key. The selected sound is generated. To change the sound volume (level 0 to 15), turn the rotary dial.

3. Check that some of the above seven test results are normal while changing the sound volume level.

4. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Memory Check

1. Turn the rotary dial to select “MEMORY” on the MANUAL CHECK screen and press the rotary dial center key. The following screen appears.


---------CONTENTS----------
/ MANUAL CHECK / SOUND
1. CONTROL B/D ROM TEST
2. CONTROL B/D RAM TEST
3. INPUT B/D ROM TEST
4. INPUT B/D RAM TEST
5. EEPROM TEST
* RETURN
---------STATUS----------
* CONTROL B/D ROM TEST: ----------
* CONTROL B/D RAM TEST: ----------
* INPUT B/D ROM TEST: ----------
* INPUT B/D RAM TEST: ----------
* EEPROM TEST

   1. CONTROL B/D ROM TEST: Calculates the check sum of the program stored in the ROM on the CONTROL board and compares the calculated sum with a check sum stored in the ROM.
   2. CONTROL B/D RAM TEST: Writes the test data to the RAM on the CONTROL board and reads the test data from the RAM.
   3. INPUT B/D ROM TEST: Calculates the check sum of the program stored in the ROM on the INPUT board and compares the calculated sum with a check sum stored in the ROM.
   4. INPUT B/D RAM TEST: Writes the test data to the RAM on the INPUT board and reads the test data from the RAM.
   5. EEPROM TEST: Calculates the check sum of the program stored in the EEPROM on the CONTROL board and compares the calculated sum with a check sum stored in the EEPROM.

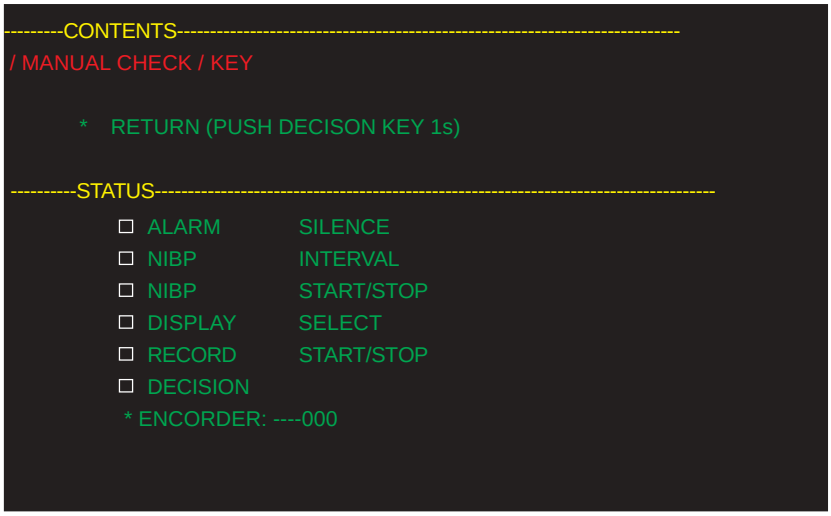
2. Turn the rotary dial to select a test and press the rotary dial center key. The selected test is indicated in yellow.

3. Check that each test result is shown as OK in the STATUS column on the screen. If there is a discrepancy in a test, the test result is shown as NG in the STATUS column on the screen.

4. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Key Check

1. Turn the rotary dial to select “KEY” on the MANUAL CHECK screen and press the rotary dial center key. The following screen appears.



ALARM SILENCE: SILENCE ALARM key
NIBP INTERVAL: NIBP INTERVAL key
NIBP START/STOP: NIBP START/STOP key
DISPLAY SELECT: Screen select key
RECORD START/STOP: Record key
DECISION: Rotary dial center key
ENCODER: Rotary dial

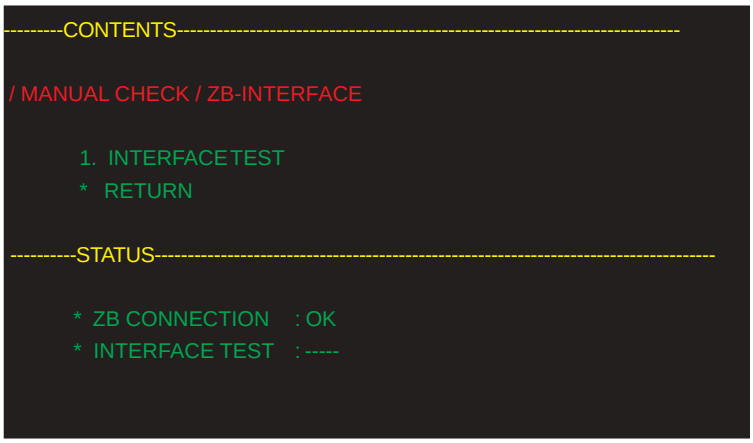
2. Press each key on the front panel and check that the square box near the key name in the STATUS column on the screen is highlighted while the key is pressed. When you turn the rotary dial, the three digit display near “ENCODER” on the screen changes from -999 to +999.

3. To return to the previous screen, press the rotary dial center key for one second.

Optional Transmitter Check

If an optional ZB-900P/ZS-900PK transmitter is not used with the instrument, skip this check.

1. Turn the rotary dial to select “ZB-INTERFACE” on the MANUAL CHECK screen and press the rotary dial center key. The following screen appears.



1. INTERFACE TEST: Checks the connection between the instrument and ZB-900P/ZS-900PK transmitter, and checks the communication between the instrument and ZB-900P/ZS-900PK transmitter.

2. Connect an optional ZB-900P/ZS-900PK transmitter to the instrument and check that “INTERFACE TEST” is indicated in yellow.

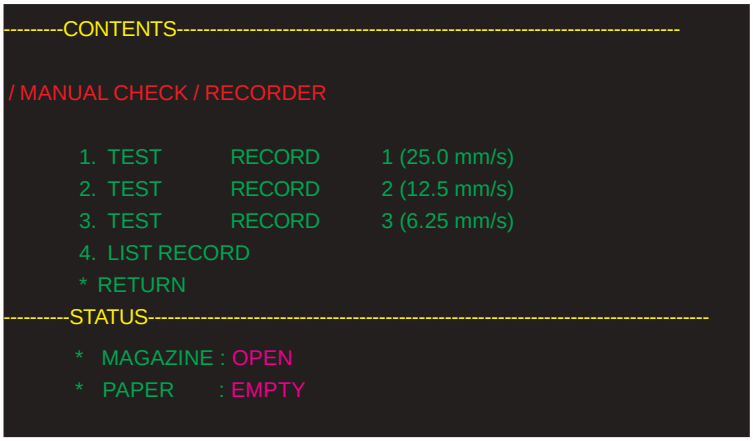
3. Press the rotary dial center key and check that “ZB CONNECTION” and “INTERFACE TEST in the STATUS column on the screen are shown as OK. If there is an error, the test result is shown as NG.

4. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Optional Recorder Check

If an optional RG-101W recorder unit is not used with the instrument, skip this check.

1. Turn the rotary dial to select “RECORDER” on the MANUAL CHECK screen and press the rotary dial center key. The following screen appears.



   1. TEST RECORD 1: Records a triangle wave at 25.0 mm/sec paper speed. 3 peaks are recorded on the paper. The peak to peak length along the time scale is 25 mm.
   2. TEST RECORD 2: Records a triangle wave at 12.5 mm/sec paper speed. 6 peaks are recorded on the paper. The peak to peak length along the time scale is 12.5 mm.
   3. TEST RECORD 3: Records a triangle wave at 6.25 mm/sec paper speed. 12 peaks are recorded on the paper. The peak to peak length along the time scale is 6.25 mm.
   4. LIST RECORD: Records the test pattern list.

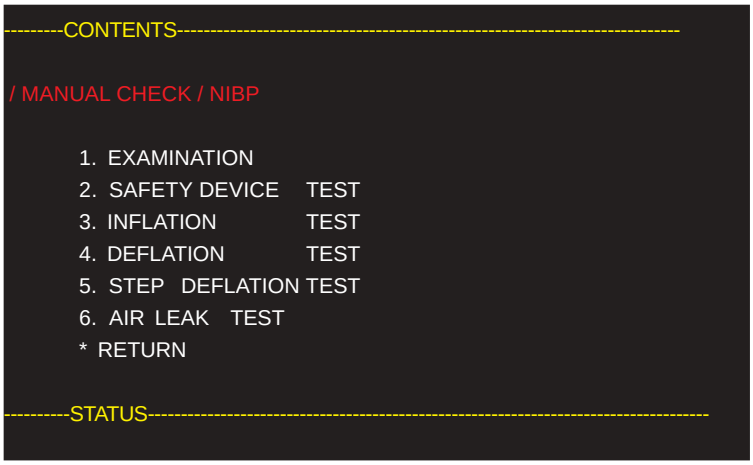
2. Turn the rotary dial to select a test and press the rotary dial center key to start the test. The selected test is indicated in yellow.

3. Check that the peak to peak length shows within ±5% tolerance on the paper at each test result, and also check that the status of “MAGAZINE” and “PAPER” in the STATUS column on the screen show “CLOSE” and “SET”, respectively. If the paper magazine is open, the “MAGAZINE” status shows “OPEN”. If there is no recording paper in the magazine, the “PAPER” status shows “EMPTY”.

4. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

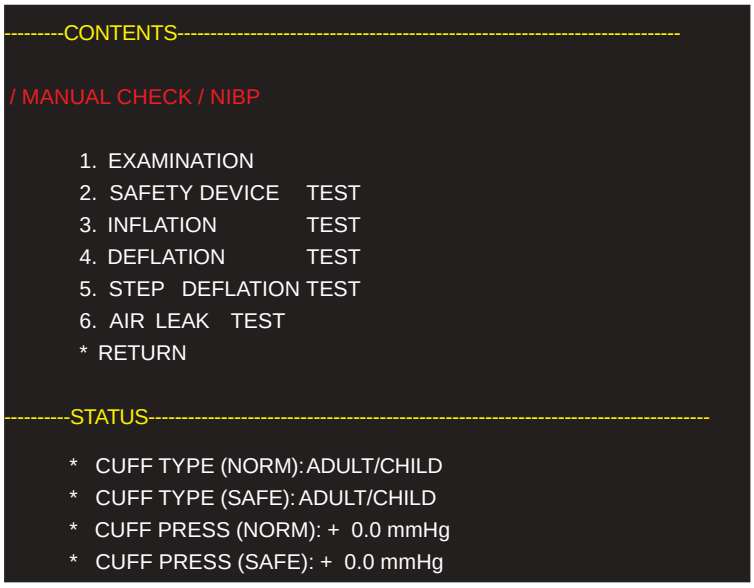
NIBP Check

Turn the rotary dial to select “NIBP” on the MANUAL CHECK screen and press the rotary dial center key. The following NIBP screen appears.



Examination

1. Connect a mercury manometer and hand bulb pump to the 700 cc dummy cuff using a Y-branch joint. Connect the dummy cuff to the instrument with an adult air hose.
2. Turn the rotary dial to select “EXAMINATION” on the NIBP screen and press the rotary dial center key to start the check. During one second zeroing, the “EXAMINATION” display color changes to white. Whenever “EXAMINATION” is executed, the zeroing is done.



CUFF TYPE (NORM): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the measurement circuit.

CUFF TYPE (SAFE): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the safety circuit.

CUFF PRESS (NORM): Indicates the cuff pressure detected at the measurement circuit.

CUFF PRESS (SAFE): Indicates the cuff pressure detected at the safety circuit.

3. Apply 100 mmHg, 200 mmHg and 300 mmHg to the dummy cuff with the hand bulb pump and compare the cuff pressures on the screen with the pressure reading from the mercury manometer.

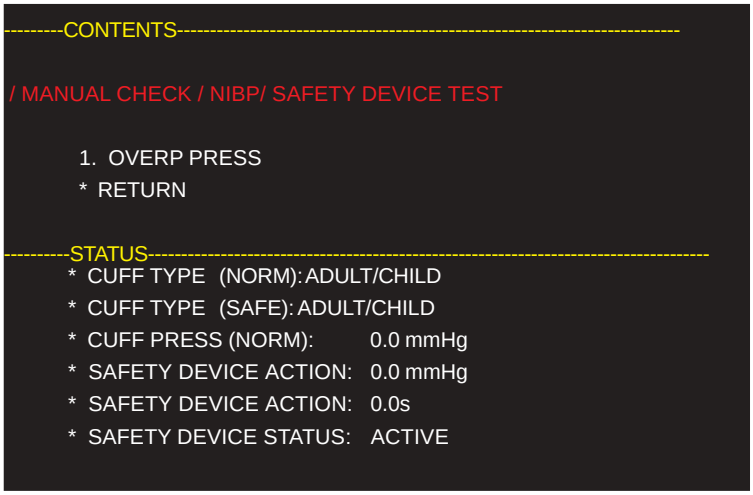
The tolerance as follows:
100 mmHg at the mercury manometer: ±3 mmHg on the screen
200 mmHg at the mercury manometer: ±4 mmHg on the screen
300 mmHg at the mercury manometer: ±4 mmHg on the screen

4. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Safety Device Test

1. Connect a mercury manometer and hand bulb pump to the 700 cc dummy cuff using a Y-branch joint. Connect the dummy cuff to the instrument with an adult air hose.

2. Turn the rotary dial to select “SAFETY DEVICE TEST” on the NIBP screen and press the rotary dial center key. The following screen appears.


---------CONTENTS----------
/ MANUAL CHECK / NIBP/ SAFETY DEVICE TEST
1. OVERP PRESS
* RETURN
----------STATUS----------
* CUFF TYPE (NORM): ADULT/CHILD
* CUFF TYPE (SAFE): ADULT/CHILD
* CUFF PRESS (NORM): 0.0 mmHg
* SAFETY DEVICE ACTION: 0.0 mmHg
* SAFETY DEVICE ACTION: 0.0s
* SAFETY DEVICE STATUS: ACTIVE

1. OVER PRESS: Checks the safety circuit operation when 300 to 315 mmHg pressure is applied to the 700 cc dummy cuff.

CUFF TYPE (NORM): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the measurement circuit.

CUFF TYPE (SAFE): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the safety circuit.

CUFF PRESS (NORM): Indicates the cuff pressure detected at the measurement circuit.

SAFETY DEVICE ACTION: Indicates the cuff pressure which works the safety circuit.

SAFETY DEVICE ACTION: Indicates the time when the safety circuit operates.

SAFETY DEVICE STATUS: Indicates the status of the safety circuit operation, INACTIVE or ACTIVE.

3. Check that “1. OVER PRESS” is selected in yellow and press the rotary dial center key to start the test.

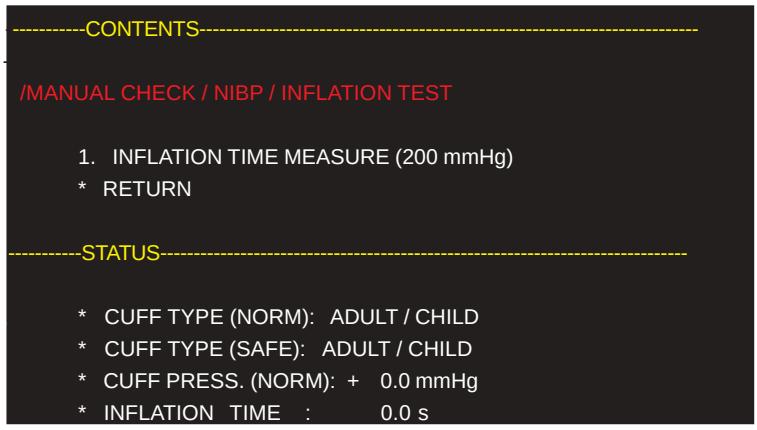
NOTE

When this test starts, the “SAFETY DEVICE STATUS” in the STATUS column on the screen changes to ACTIVE. If 300 to 315 mmHg pressure is not applied to the dummy cuff within 15 seconds from the start time, the “SAFETY DEVICE STATUS” returns to INACTIVE.

4. Apply 300 to 315 mmHg pressure to the dummy cuff with the hand bulb pump.
5. Check that “CUFF PRESS (NORM) in the STATUS column on the screen and the mercury manometer shows 0 mmHg.
6. Check that the time of “SAFETY DEVICE ACTION” in the STATUS column on the screen shows 15 seconds or less.
7. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Inflation Test

1. Connect the 700cc dummy cuff to the instrument with an adult air hose. Since the other tube of the dummy cuff must be completely closed, pinch the tube with a pinch clamp.
2. Turn the rotary dial to select “INFLATION TEST” on the NIBP screen and press the rotary dial center key. The following screen appears.


----------CONTENTS----------
/MANUAL CHECK / NIBP / INFLATION TEST
1. INFLATION TIME MEASURE (200 mmHg)
* RETURN
----------STATUS----------
* CUFF TYPE (NORM): ADULT / CHILD
* CUFF TYPE (SAFE): ADULT / CHILD
* CUFF PRESS. (NORM): + 0.0 mmHg
* INFLATION TIME : 0.0 s

1. INFLATION TIME MEASURE (200 mmHg): Measures the inflation time when the cuff pressure is automatically inflated to 200 mmHg.

CUFF TYPE (NORM): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the measurement circuit.

CUFF TYPE (SAFE): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the safety circuit.

CUFF PRESS (NORM): Indicates the cuff pressure detected at the measurement circuit.

INFLATION TIME: Indicates the inflation time which it takes for the cuff pressure to reach 200 mmHg from 0 mmHg.

3. Check that the “1. INFLATION TIME MEASURE (200 mmHg)” is selected in yellow and press the rotary dial center key to start the test.

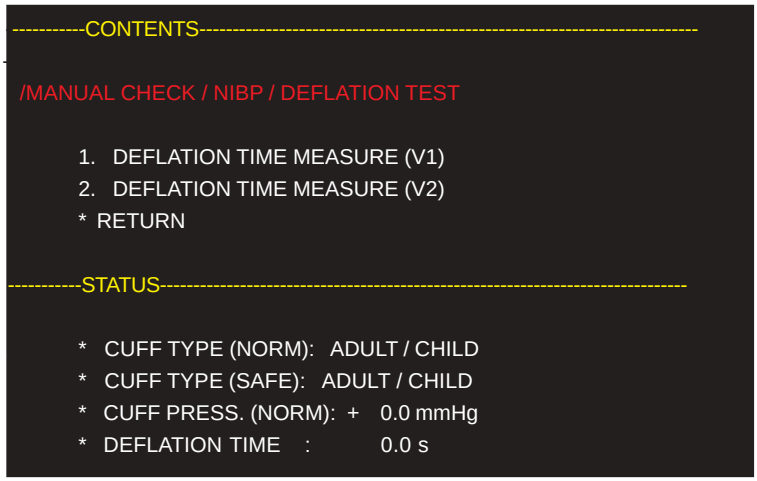
4. Check that “INFLATION TIME“ in the STATUS column on the screen shows 7 seconds or less.

5. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Deflation Test (Quick deflation test)

1. Connect a mercury manometer and hand bulb pump to the 700 cc dummy cuff using a Y-branch joint. Connect the dummy cuff to the instrument with an adult air hose.

2. Turn the rotary dial to select “DEFLATION TEST” on the NIBP screen and press the rotary dial center key. The following screen appears.


----------CONTENTS----------
/MANUAL CHECK / NIBP / DEFLATION TEST
1. DEFLATION TIME MEASURE (V1)
2. DEFLATION TIME MEASURE (V2)
* RETURN
----------STATUS----------
* CUFF TYPE (NORM): ADULT / CHILD
* CUFF TYPE (SAFE): ADULT / CHILD
* CUFF PRESS. (NORM): + 0.0 mmHg
* DEFLATION TIME : 0.0 s

1. DEFLATION TIME MEASURE (V1): Measures the time when the valve 1 is open and the cuff pressure reaches 15 mmHg after 300 mmHg pressure is applied to the 700 cc dummy cuff.
2. DEFLATION TIME MEASURE (V2): Measures the time when the valve 2 is open and the cuff pressure reaches 15 mmHg after 300 mmHg pressure is applied to the 700 cc dummy cuff.

CUFF TYPE (NORM): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the measurement circuit.

CUFF TYPE (SAFE): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the safety circuit.

CUFF PRESS (NORM): Indicates the cuff pressure detected at the measurement circuit.

DEFLATION TIME: Indicates the deflation time which it takes for the cuff pressure to reach 15 mmHg after the valve 1 or valve 2 opens.

3. Apply 300 mmHg pressure to the dummy cuff with the hand bulb pump, turn the rotary dial to select “1. DEFLATION TIME MEASURE (V1)” and press the rotary dial center key to start the test.

4. Check that “DEFLATION TIME” in the STATUS column on the screen shows 6 seconds or less.

5. Turn the rotary dial to select “RETURN” and press the rotary dial center key. The previous NIBP screen appears. Enter the Deflation Test screen again by selecting “DEFLATION TEST” with the rotary dial and pressing the rotary dial center key.

NOTE

When either deflation test is completed, exit the Deflation Test screen by selecting “RETURN” with the rotary dial and pressing the rotary dial center key. Then, enter the Deflation Test screen again. Otherwise, the applied 300 mmHg pressure is not held before the second test starts.

6. Apply 300 mmHg pressure to the dummy cuff with the hand bulb pump, turn the rotary dial to select “2. DEFLATION TIME MEASURE (V2)” and press the rotary dial center key to start the test.

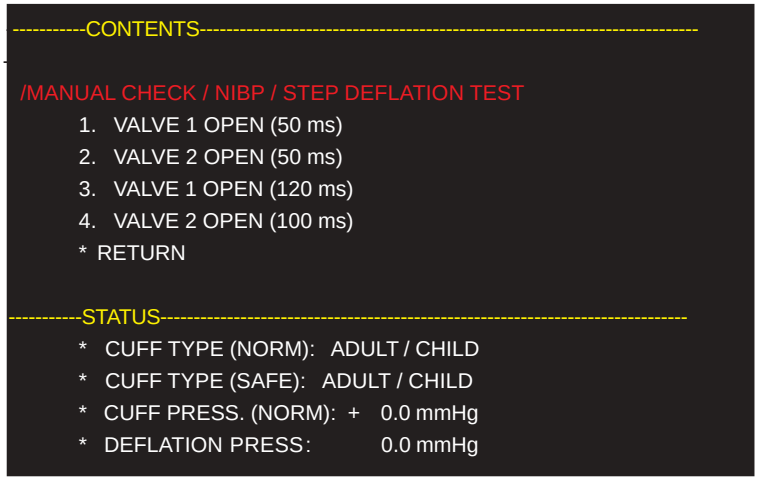
7. Check that “DEFLATION TIME” in the STATUS column on the screen shows 14 seconds or less.

8. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Step Deflation Test

1. Connect a mercury manometer and hand bulb pump to the 250 cc dummy cuff using a Y-branch joint. Connect the dummy cuff to the instrument with an adult air hose.

2. Turn the rotary dial to select “STEP DEFLATION TEST” on the NIBP screen and press the rotary dial center key. The following screen appears.


----------CONTENTS----------
/MANUAL CHECK / NIBP / STEP DEFLATION TEST
1. VALVE 1 OPEN (50 ms)
2. VALVE 2 OPEN (50 ms)
3. VALVE 1 OPEN (120 ms)
4. VALVE 2 OPEN (100 ms)
* RETURN
----------STATUS----------
* CUFF TYPE (NORM): ADULT / CHILD
* CUFF TYPE (SAFE): ADULT / CHILD
* CUFF PRESS. (NORM): + 0.0 mmHg
* DEFLATION PRESS: 0.0 mmHg

1. VALVE 1 OPEN (50 ms): Measures the variation of the cuff pressure when 250 mmHg pressure is applied to the 250 cc dummy cuff and the valve 1 opens for 50 ms.
2. VALVE 2 OPEN (50 ms): Measures the variation of the cuff pressure when 250 mmHg pressure is applied to the 70 cc dummy cuff and the valve 2 opens for 50 ms.
3. VALVE 1 OPEN (120 ms): Measures the variation of the cuff pressure when 20 mmHg pressure is applied to the 250 cc dummy cuff and the valve 1 opens for 120 ms.
4. VALVE 2 OPEN (100 ms): Measures the variation of the cuff pressure when 20 mmHg pressure is applied to the 70 cc dummy cuff and the valve 2 opens for 100 ms.

CUFF TYPE (NORM): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the measurement circuit.

CUFF TYPE (SAFE): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the safety circuit.

CUFF PRESS (NORM): Indicates the cuff pressure detected at the measurement circuit.

DEFLATION PRESS: Indicates the pressure variation when the valve 1 or valve 2 opens for the specified time.

3. Apply 250 mmHg pressure to the dummy cuff with the hand bulb pump, turn the rotary dial to select “1. VALVE 1 OPEN (50 ms)” and press the rotary dial center key to start the test.

4. Check that “DEFLATION PRESS” in the STATUS column on the screen shows 7 to 23 mmHg.

5. Apply 20 mmHg pressure to the dummy cuff with the hand bulb pump, turn the rotary dial to select “3. VALVE 1 OPEN (120 ms)” and press the rotary dial center key to start the test.

6. Check that “DEFLATION PRESS” in the STATUS column on the screen shows 2 to 8 mmHg.

7. Replace the 250 cc dummy cuff with a 70 cc dummy cuff and replace the adult air hose with a neonatal air hose.

8. Apply 250 mmHg pressure to the dummy cuff with the hand bulb pump, turn the rotary dial to select “2. VALVE 2 OPEN (50 ms)” and press the rotary dial center key to start the test.

9. Check that “DEFLATION PRESS” in the STATUS column on the screen shows 5 to 15 mmHg.

10. Apply 20 mmHg pressure to the dummy cuff with the hand bulb pump, turn the rotary dial to select “4. VALVE 2 OPEN (100 ms)” and press the rotary dial center key to start the test.

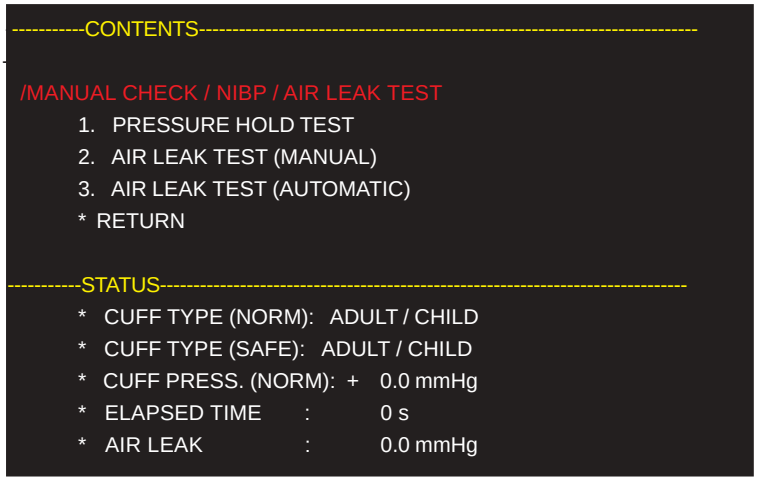
11. Check that “DEFLATION PRESS” in the STATUS column on the screen shows 5 to 15 mmHg.

12. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

Air Leak Test

1. Connect the dummy cuff to the instrument with an adult air hose. Since the other tube of the dummy cuff must be completely closed, pinch the tube with a pinch clamp.

2. Turn the rotary dial to select “AIR LEAK TEST” on the NIBP screen and press the rotary dial center key. The following screen appears.


----------CONTENTS----------
/MANUAL CHECK / NIBP / AIR LEAK TEST
1. PRESSURE HOLD TEST
2. AIR LEAK TEST (MANUAL)
3. AIR LEAK TEST (AUTOMATIC)
* RETURN
----------STATUS----------
* CUFF TYPE (NORM): ADULT / CHILD
* CUFF TYPE (SAFE): ADULT / CHILD
* CUFF PRESS. (NORM): + 0.0 mmHg
* ELAPSED TIME : 0 s
* AIR LEAK : 0.0 mmHg

1. PRESSURE HOLD TEST: Measures the pressure difference between the two cuff pressures at 10 seconds after and at 20 seconds after 300 mmHg pressure is applied to the 700 cc dummy cuff.
2. AIR LEAK TEST (MANUAL): Measures the pressure difference between the two cuff pressures at 30 seconds after and at 90 seconds after 300 mmHg pressure is applied to the 700 cc dummy cuff.
3. AIR LEAK TEST (AUTOMATIC): Measures the pressure difference between the two cuff pressures at 60 seconds after and at 120 seconds after 300 mmHg pressure is automatically applied to the 700 cc dummy cuff.

CUFF TYPE (NORM): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the measurement circuit.

CUFF TYPE (SAFE): Indicates the type of the air hose connected to the instrument, “ADULT/CHIL” or “NEONATAL”. The air hose type is recognized by the safety circuit.

CUFF PRESS (NORM): Indicates the cuff pressure detected at the measurement circuit.
ELAPSED: Indicates the elapsed time after this test starts.
AIR LEAK: Indicates the air leakage pressure.

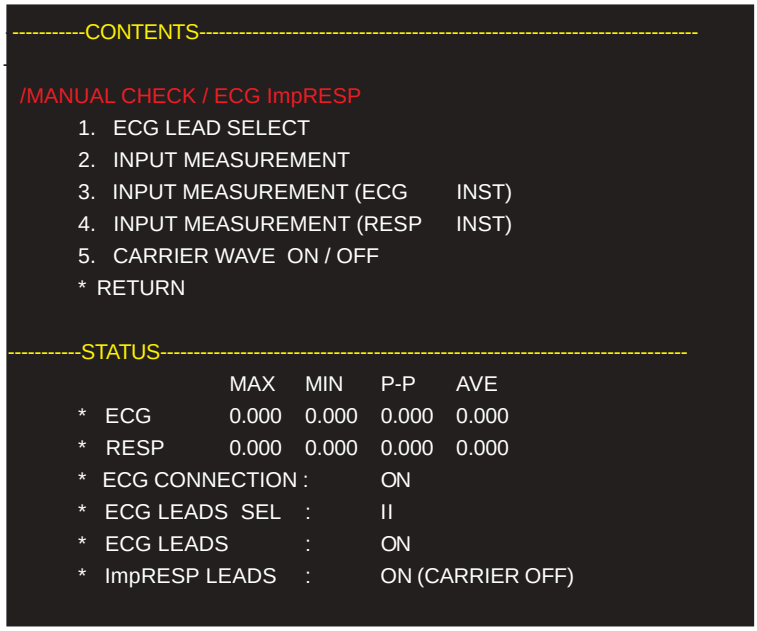
3. Turn the rotary dial to select “3. AIR LEAK TEST (AUTOMATIC)” on the screen and press the rotary dial center key to start the test.

4. Check that “AIR LEAK” in the STATUS column on the screen shows 8 mmHg or less.

5. To return to the previous screen, turn the rotary dial to select “RETURN” and press the rotary dial center key.

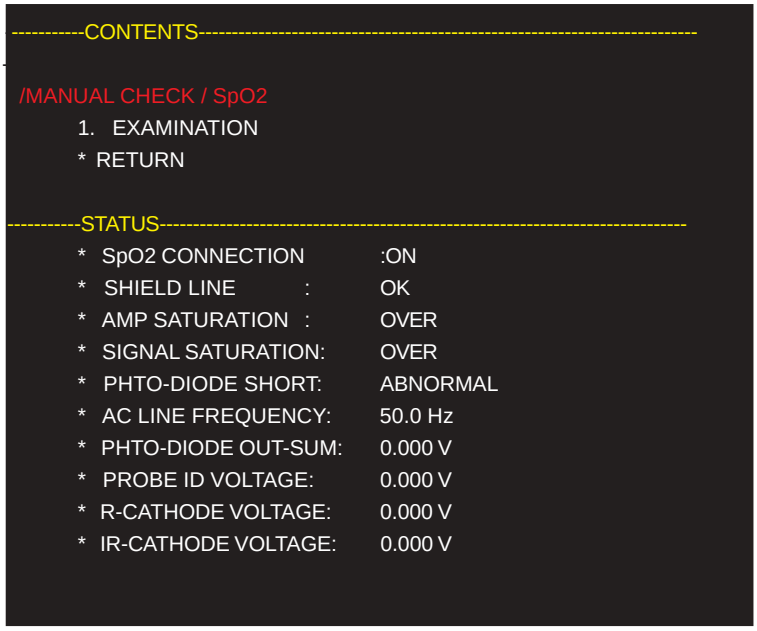
ECG and Impedance Method Respiration Checks

These checks are factory use only.


----------CONTENTS----------
/MANUAL CHECK / ECG ImpRESP
1. ECG LEAD SELECT
2. INPUT MEASUREMENT
3. INPUT MEASUREMENT (ECG INST)
4. INPUT MEASUREMENT (RESP INST)
5. CARRIER WAVE ON / OFF
* RETURN
----------STATUS----------
MAX MIN P-P AVE
* ECG 0.000 0.000 0.000 0.000
* RESP 0.000 0.000 0.000 0.000
* ECG CONNECTION : ON
* ECG LEADS SEL : II
* ECG LEADS : ON
* ImpRESP LEADS : ON (CARRIER OFF)

SpO2 Check

This check is factory use only.



Section 4 Board/Unit Description

Block Diagram 4.1

Input Board 4.2
- NIBP Block 4.2
- SpO2 Block 4.2
- ECG Block 4.2
- RESP Block 4.2
- Control Block 4.2
- Isolated Power Supply Block 4.2

POWER Board 4.3

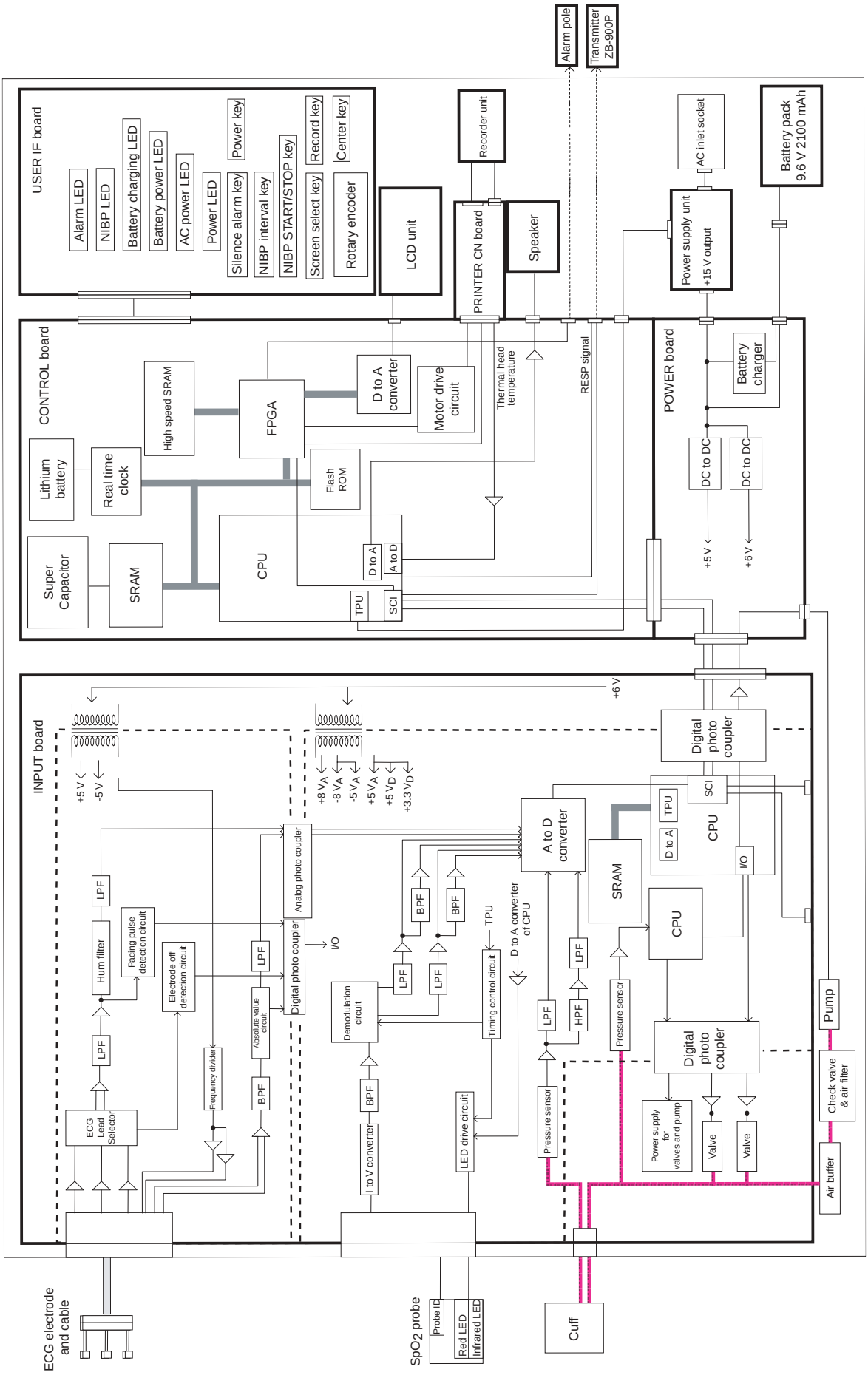
USER IF Board 4.3

PRINTER CN Board 4.3

CONTROL Board 4.3

Power Supply Unit 4.3

Block Diagram



INPUT Board

This board consists of the following blocks. The vital sign data processed on this board is sent to the CONTROL board by serial data communication.

NIBP block

Pressure control circuit: Controls the cuff inflation and deflation.
Pressure measurement circuit: Measures the cuff pressure.
Pulse complex amplifier: Amplifies the pulse complex signal (variation component from the cuff pressure) and filters it.

SpO_2 block

LED emission control circuit: Controls the emission timing of the two LEDs in the SpO_2 probe.
Photo sensor amplifier: Processes the current which is converted from the amount of the received light at the photo sensor, and amplifiers the time-sharing signal through the band pass filter.
SpO_2 probe failure detection circuit: Detects a failure of the SpO_2 probe.

ECG block

Lead selector: Selects an ECG lead from the leads I, II, and III.
ECG amplifier: Filters the ECG input signal selected by the lead selector and amplifiers the signal.
Pacing pulse detection circuit: Detects pacing pulse.
Electrode off detection circuit: Detects that an electrode is detached from the patient skin.

RESP block

Carrier wave generator: Generates the carrier wave for the modulation of respiration signal. The carrier wave can be set to on or off.
Demodulation circuit: Demodulates the respiration signal from the carrier wave.
Electrode status detection: Detects each electrode status.

Control block

Processes the vital sign data and sends it to the CONTROL board by serial data communication.

Isolated power supply block

Generates the various supply voltages for the isolation circuit.

POWER Board

This board consists of the following blocks which includes the DC to DC converter from the power supply unit or rechargeable battery, AC or battery operation selector and battery charger.
DC to DC conversion block: Converts the 15 V DC (from the power supply unit) or the battery voltage to 5 V, 6 V and 12 V DC.
AC or battery operation selector block: Switches to the battery operation when the line voltage is not supplied to the instrument. When the line voltage is supplied to the instrument in the battery operation, this selector switches to the AC operation.
Battery charger block: Charges the battery (nickel metal-hydride battery pack) in quick charge mode and trickle charge mode.

USER IF Board

This board has the keys, rotary encoder and LEDs. Refer to “Front Panel” and “Power Panel” in Section 1 Panel Description.

PRINTER CN Board

This board has the following components.

- Three connectors to connect to the CONTROL board and optional recorder unit
- High capacitance capacitors to smooth the supply voltage for the optional recorder unit

CONTROL Board

This board controls the following functions.

- Serial data communication with the INPUT board
- Display of waveform and alphanumeric data, LED indicators and optional recorder unit
- Keys and rotary encoder
- Speaker sound
- Optional transmitter and alarm pole

Power Supply Unit

This unit converts the line voltage to +15 V DC.

Section 5 Disassembly and Assembly

Opening the Instrument 5.1
- Removing the Rear Enclosure 5.1
- Separating the Front Enclosure and Chassis Block 5.1
- Removing the LCD Unit 5.2
- Removing the USER IF Board 5.2
- Removing the INPUT Board 5.3
- Removing the NIBP Pump 5.4
- Removing the POWER Board, CONTROL Board and PRINTER CN Board 5.4
- Removing the Recorder Unit (Option) 5.5
- Removing the POWER Board 5.5
- Removing the CONTROL Board 5.5
- Removing the PRINTER CN Board 5.6
- Removing the Power Supply Unit 5.6

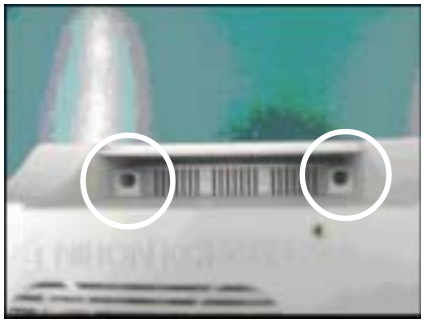
Replacing the Lithium Battery 5.7

Installing the Optional RG-101W Recorder Unit 5.8

Opening the Instrument

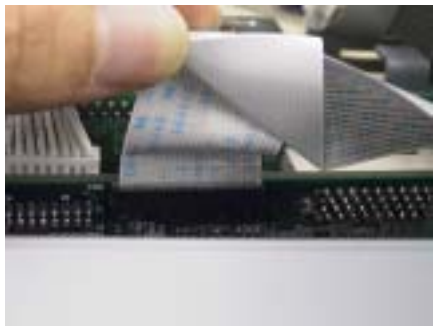
Removing the Rear Enclosure

1. Remove the 4 screws which secure the rear enclosure to the instrument. Remove the rear enclosure from the instrument.



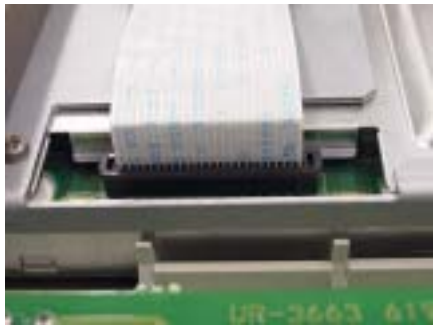
Separating the Front Enclosure and Chassis Block

2. Disconnect the 2 wire harnesses from the CONTROL board.



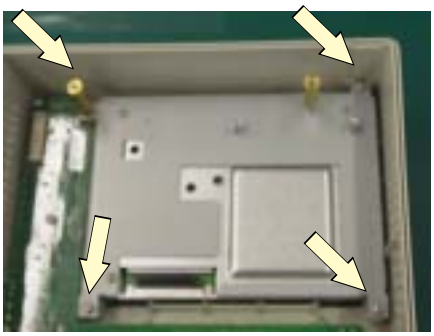
3. Remove the 4 screws which secure the chassis block to the front enclosure as shown below. Separate the front enclosure and chassis block.

4. Disconnect the wire harness from the LCD unit.

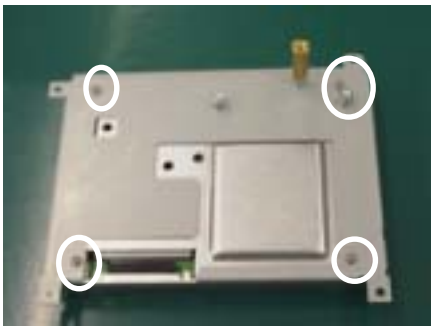


Removing the LCD Unit

5. Remove the 3 screws and hexagonal spacer bolt which secure the LCD unit to the front enclosur. Remove the LCD unit from the front enclosure.



6. Remove the 4 screws which secure the holder to the LCD unit. Remove the holder from the LCD unit.



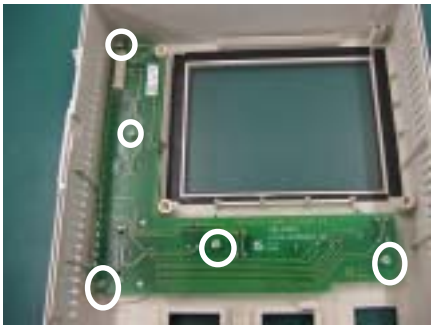
CAUTION
in Assembling the Instrument
Use a present torque Phillips screwdriver when attaching the LCD unit holder to the LCD unit. Use 4±0.4 Kgf/cm force.

Removing the USER IF Board

7. Disconnect the wire harness from the USER IF board of the front enclosure.

CAUTION
in Assembling the Instrument
Do not pinch any wire of the wire harness when attaching the ferrite core clamp to the wire harness.

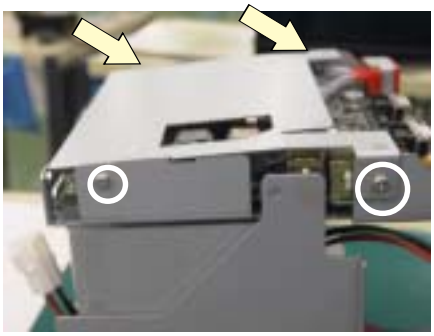
8. Remove the 5 screws which secure the USER IF board to the front enclosure. Remove the USER IF board from the front enclosure.



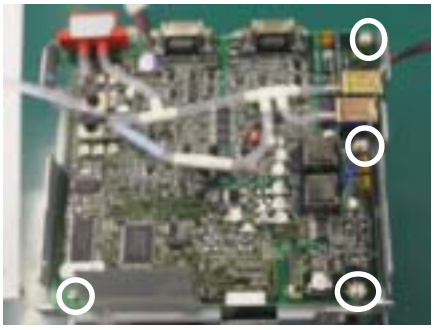
Removing the INPUT Board

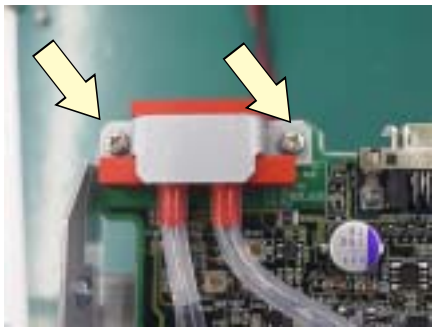
Perform the following procedure after the “Separating the Front Enclosure and Chassis Block” procedure.

1. Remove the 4 screws which secure the shield cover to the INPUT board. Remove the shield cover from the INPUT board.

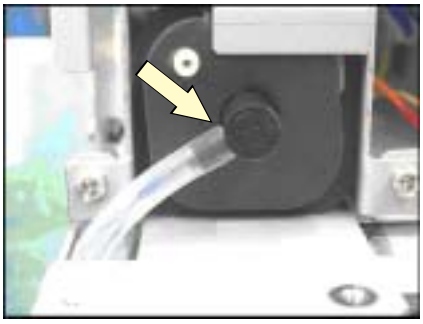


2. Remove the 6 screws which secure the insulation sheet and NIBP socket holder to the INPUT board.





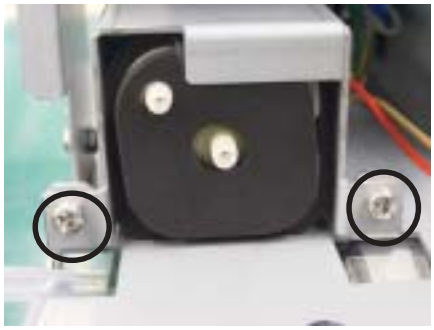
3. Disconnect the air tube from the NIBP pump.

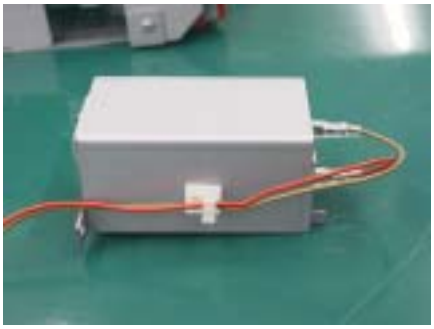


4. Disconnect the wire harness from the other side of the INPUT board. Remove the INPUT board from the chassis block.

Removing the NIBP Pump

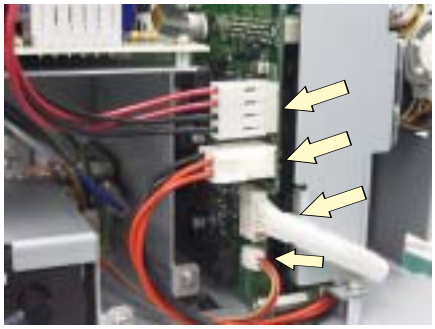
5. Remove the 2 screws which secure the NIBP pump to the chassis block. Disconnect the wire harness of the NIBP pump from the POWER board. Remove the NIBP pump from the chassis block.

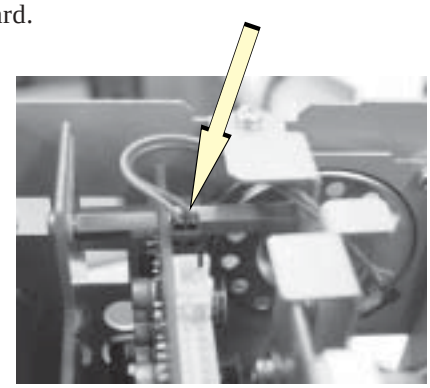




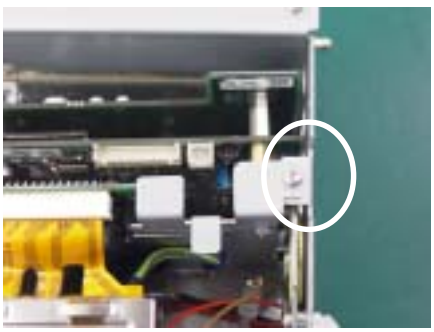
Removing the POWER Board, CONTROL Board and PRINTER CN Board

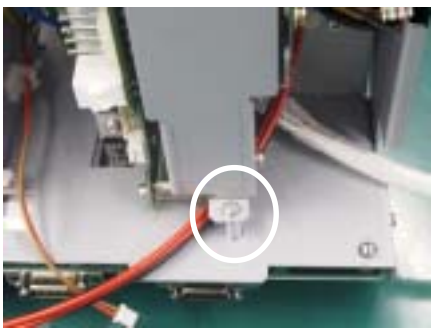
6. Disconnect the 5 wire harnesses from the POWER board and disconnect the wire harness from the CONTROL board.





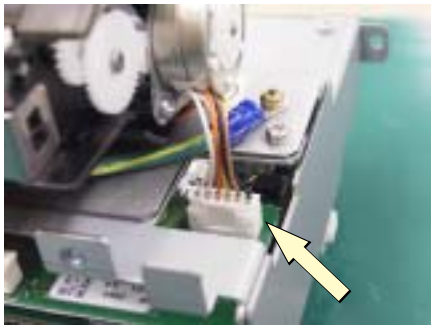
7. Remove the following 3 screws. From the chassis block, remove the POWER board, CONTROL board and PRINTER CN board (including the optional recorder unit if it is built in the instrument). If there is no recorder unit, go to step 10.





Removing the Recorder Unit (Option)

8. Disconnect the 2 wire harnesses from the PRINTER CN board.

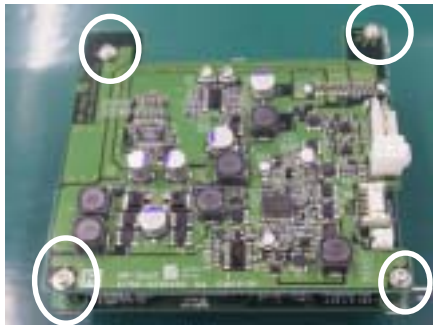


9. Remove the 3 screws which secure the recorder unit to the chassis block.

CAUTION
in Assembling the Instrument
The two screws circled in the left picture are 6 mm long. The screw indicated by the arrow is 8 mm long.

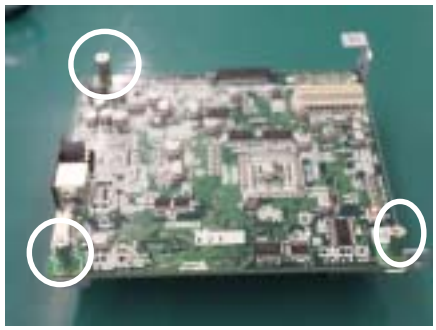
Removing the POWER Board

10. Remove the 4 screws which secure the POWER board to the CONTROL and PRINTER CN boards. Remove the POWER board from the CONTROL and PRINTER CN boards.



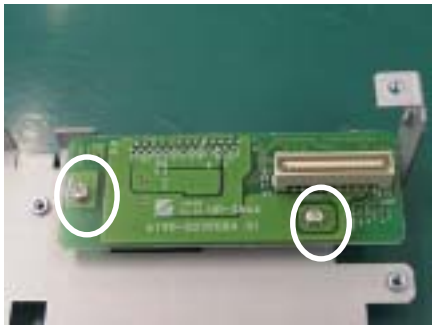
Removing the CONTROL Board

11. Remove the 3 hexagonal spacer bolts which secure the CONTROL board to the PRINTER CN board. Remove the CONTROL board from the PRINTER CN board.



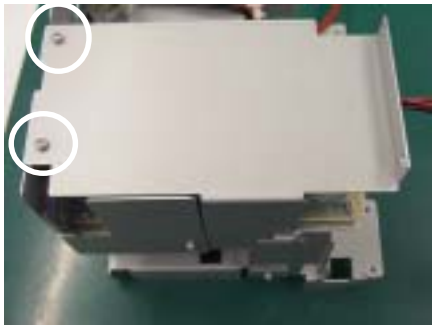
Removing the PRINTER CN Board

12. Remove the 2 screws which secure the PRINTER CN board to the recorder unit guide. Remove the PRINTER CN board from the recorder unit guide.



Removing the Power Supply Unit

13. Remove the 2 screws which secure the top chassis to the chassis block. Remove the top chassis from the chassis block. The power supply unit can be seen.



14. Disconnect the 2 wire harnesses from the power supply unit and remove the 4 screws which secure the power supply unit to the chassis block. Remove the power supply unit from the chassis block.

Replacing the Lithium Battery

Perform the following procedure after the “Removing the CONTROL Board” procedure.

CAUTION

- **Use a glove to handle the new lithium battery. If you touch it with your bare hand, it may cause an increase of resistance at the battery terminals and shorten the lifetime.**
- **Never charge, short-circuit, disassemble, deform, heat, or throw the battery into fire. This may cause overheating, explosion, or fire.**
- **Before disposing of the battery, cover it with insulation tape to prevent short circuit between the positive and negative terminals. Otherwise, the battery may heat, explode or burn if the battery is disposed of with other batteries or electrically conductive materials.**
- **Discard used batteries according to your local laws.**

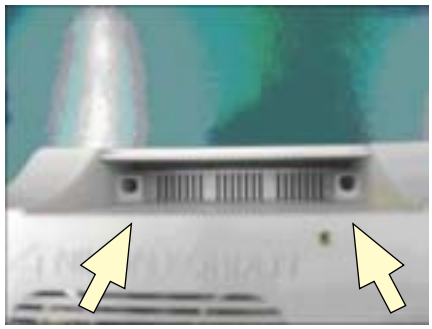
1. Replace the lithium battery on the CONTROL board with a new one.

2. After the battery replacement, check the continuity between the battery terminal and receptacle terminal with a multimeter or digital voltmeter.

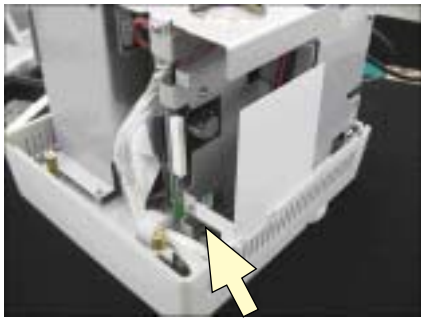
Installing the Optional RG-101W Recorder Unit

1. Remove the 4 screws and remove the rear enclosure.

M3×6 pan screw with spring washer



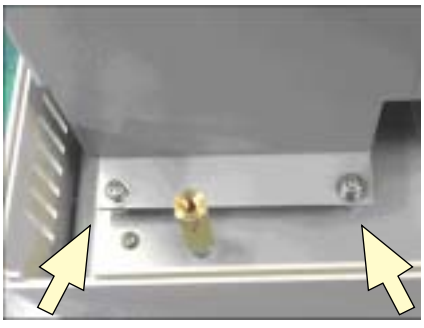
2. Remove the screw which secures the recorder blank panel to the instrument and remove the blank panel.



M3×6 pan head screw with spring washer

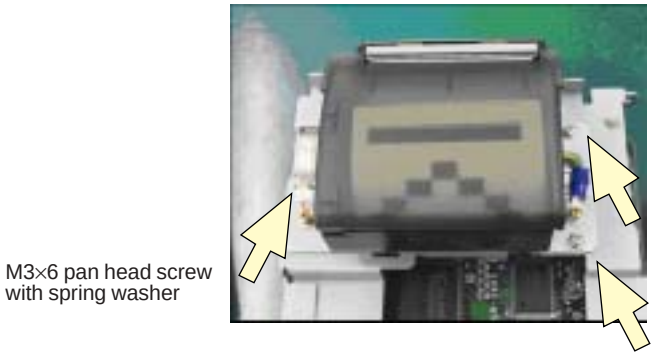
3. Remove the 2 wire harnesses from the CONTROL board.

4. Remove the 4 screws and remove the chassis block from the front enclosure.

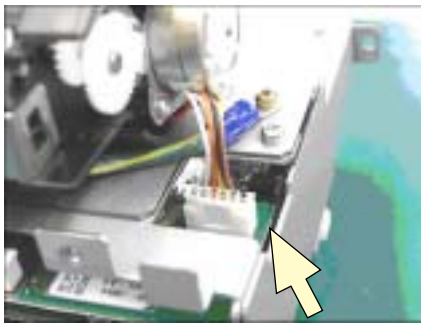


M3×6 pan head screw with spring washer

5. Attach the recorder unit to the chassis and secure the unit with the 2 M3×6 screws and M3×8 screw.



6. Connect 2 wire harnesses as shown below.



7. Assemble the instrument by reversing steps 1 to 4.

Section 6 Maintenance

To Be Replaced Periodically 6.1
Required Tools 6.1
Measuring and Test Equipment 6.2
Maintenance Check Items and Schedule 6.3
- External 6.3
- Input Conditions 6.3
- Power 6.4
- Operations 6.4
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- RESP 6.5
- NIBP 6.5
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- Alarm 6.6
- Clock 6.6
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- Safety 6.7
- Installation Condition 6.7

To Be Replaced Periodically

We recommend the periodic replacement of the following components according to the expected life span.

NK Code No.	Description	Expected Life Span
481809	Lithium battery for clock operation backup	Approx. 6 years or more
X064	Battery pack NKB-302	Once a year

Required Tools

- Long-bladed Phillips screwdriver (insulated) with magnetized tip
- Long-bladed flat screwdriver (insulated) with magnetized tip
- Anti-static bench mat connected to appropriate ground
- Anti-static wrist strap connected to appropriate ground
- 3 mm hex socket driver
- Tweezers
- Nippers
- Cable ties

Measuring and Test Equipment

To repair, check, or adjust the instrument, the following measuring and test equipment or equipment with similar function and performance is required.

Digital Voltmeter
A digital tester with at least 3-1/2 digits LCD display that can measure voltage, current, and resistance.

Cathode-ray Oscilloscope
An oscilloscope with a bandwidth of more than 1 MHz and a sensitivity of more than 10 mV/cm.

AX-800P Vital Sign Simulator

AX-300T SpO_2 Simulator

YS-077P1 NIBP Dummy Cuff
A 700 mL container that is needed for some NIBP check items in the diagnostic check mode.

YS-077P2 NIBP Dummy Cuff
A 250 mL container that is needed for some NIBP check items in the diagnostic check mode.

6443-000022B NIBP Dummy Cuff
A 72 mL container that is needed for some NIBP check items in the diagnostic check mode.

Mercury Manometer with Hand Pump

Y-branch hose joint*

YN-101T Air hose for adult and child (3.5 m long)**

YN-121T Air hose for neonate (3.6 m long)

*Purchase locally.
** Included in the accessory kit.

Maintenance Check Items and Schedule

Perform this maintenance check once every six months.

A maintenance check sheet is provided at the end of this section. Make a copy of this check sheet before using it. The check items are grouped as follows:

- External
- Input conditions
- Power
- Operation
- Display
- Sound
- ECG
- RESP
- NIBP
- SpO_2
- Alarm
- Clock
- Optional Recorder Built in the Instrument
- Optional Transmitter Attached to the Instrument
- Safety
- Installation Condition

Following are the procedures for each check item.

NOTE

If you change the instrument setting for a check item, write down the setting before changing it. After finishing the check item, return the setting to the previous setting.

External

Item	Check Procedure	Action
Dirt, stain or damage of enclosure and key membrane sheet	Visually check that there is no dirt, stain and damage on the instrument.	If the instrument is dirty, clean it with a cloth moistened with water, neutral soap or alcohol. If the instrument has stain or damage, remove it or replace the stained or damaged part with a new one.
Loose or lost screw	Check that there is no loose or lost screw on the instrument.	If there is a loose screw, secure it tightly. If a screw is lost, get a new one and secure it tightly.
Free component, screw or foreign matter in the instrument	Lift the instrument, and shake it, and check that there is no rattling of anything in the instrument.	If there is rattling of something, disassemble the instrument and fix the cause.

Input Conditions

Item	Check Procedure	Action
Input sockets on the instrument and connection cord connectors	Visually check that there is no damaged input socket and connector.	If the input socket or connector is damaged, replace it with a new one.
Contact between input socket on the instrument and connector of connection cord	Check that there is good contact between the input socket and connector of the connection cord.	Remove the cause if there is a poor contact between them.

Power

Item	Check Procedure	Action
Line voltage	Check that the line voltage is within the range of nominal voltage ± 10%.	Use only the line voltage within the correct range.
Power cord	Check that the power cord does not have any damage, poor continuity, heat, sound or smell while bending each part of the power cord.	If the power cord has a tailure, replace it with a new one.
	Check that the ground wire of the power cord has a resistance of 0.1 Ω or less between the ends.	
Ground lead	Check that the ground lead has no damage and no poor continuity while bending each part of the ground lead.	If the ground lead has a tailure, replace it with a new one.
Fuse	Check that the specified fuses are used and not blown.	If the fuse is blown, replace it with a new one after removing the cause.
Power indicator and supply voltage check	Check that the power indicators such as the power lamp, AC power lamp and battery power lamp works properly and the correct voltages are output from the power supply unit.	Remove the cause if there is anything wrong.

Operation

Item	Check Procedure	Action
Key function	Select “KEY” on the MANUAL CHECK screen, and perform the key check items, and check that there is no error. Refer to “Key Check” in Section 3 of this manual.	Remove the cause if an error occurs.

Display

Item	Check Procedure	Action
Crack, scratch or dirt on the LCD	Check that there is no crack, scratch and dirt on the LCD.	If there is a crack or scratch on the screen, replace it with a new one. If the screen is dirty, clean it with a soft cloth moistened with water.
Display function	Select “DISPLAY” on the MANUAL CHECK screen, and perform the display check items, and check that there is no error. Refer to “Display Check” in Section 3 of this manual.	Remove the cause if an error occurs.

Sound

Item	Check Procedure	Action
Sound function	Select "SOUND" on the MANUAL CHECK screen, and perform the sound check items, and check that there is no error. Refer to "Sound Check" in Section 3 of this manual.	Remove the cause if an error occurs.

ECG

Item	Check Procedure	Action
Electrode lead wire and connection cord wire	Check that there is no break of the lead wire and connection cord with a multimeter or digital voltmeter.	If the electrode lead wire or connection cord wire has a break, replace it with a new one.
	Visually check that there is no dirt at the connector pins and electrode contact parts	If the connector pins or electrode contact part is dirty, clean them.
ECG waveform	Contact the AX-800P to the instrument through the electrode lead and connection cord and check that the waveform is displayed properly.	Replace the INPUT board with a new one if an error occurs.
Heart rate	Connect the AX-800P to the instrument through the electrode lead and connection cord and check that the heart rate is displayed properly.	Replace the INPUT board with a new one if an error occurs.

RESP

Item	Check Procedure	Action
Respiration waveform	Connect the AX-800P to the instrument through the electrode lead and connection cord and check that the waveform is displayed properly.	Replace the INPUT board with a new one if an error occurs.
Respiration rate	Connect the AX-800P to the instrument through the electrode lead and connection cord and check that the respiration rate is displayed properly.	Replace the INPUT board with a new one if an error occurs.

NIBP

Item	Check Procedure	Action
Pressure sensors	Refer to "Examination" at "NIBP Check" in Section 3 of this manual. Check that there is no error.	Replace the INPUT board with a new one if an error occurs.
Safety circuit	Refer to "Safety Device Test" at "NIBP Check" in Section 3 of this manual. Check that there is no error.	Replace the INPUT board with a new one if an error occurs.
NIBP pump	Refer to "Inflation Test" at "NIBP Check" in Section 3 of this manual. Check that there is no error.	Replace the NIBP pump with a new one if an error occurs.
Valves	Refer to "Quick Deflation Test" and "Step Deflation Test" at "NIBP Check" in Section 3 of this manual. Check that there is no error.	Replace the valve with a new one if an error occurs.
Internal pneumatic path	Refer to "Air Leak Test" at "NIBP Check" in Section 3 of this manual. Check that there is no error.	Remove the cause if an error occurs.
NIBP measurement	Check that the NIBP measurement is done properly.	Remove the cause if an error occurs.

SpO_2

Item		Check Procedure	Action
Probe	TL-201T finger probe	Refer to "STATUS: SIGNAL LEVEL" at "SpO2 Setup" in Section 3 of the operator's manual. Check that the signal level is more than half the level of the first use.	Replace the probe with a new one if the signal level is half or less than half the level of the first use.
		Connect the probe to the AX-300T and put the provided check board between the light emitter and photo detector, and hold this condition, and check that the AX-300T displays "OK".	Replace the probe with a new one if the AX-300T shows an error.
	The other probes	Connect the probe to the AX-300T and put the provided check board between the light emitter and photo detector, and hold this condition, and check that the AX-300T shows "OK".	Replace the probe with a new one if the AX-300T shows an error.
SpO2 data		Connect the AX-300T to the instrument and check that the data is displayed within the following tolerance to the AX-300T setting. 97%±2, 80%±2, 70%±3	Replace the INPUT board with a new one if an error occurs.
Pulse rate		Connect the AX-300T to the instrument and check that the pulse rate is displayed within the following tolerance to the AX-300T setting. 60±5, 120±8	Replace the INPUT board with a new one if an error occurs.

Alarm

Item	Check Procedure	Action
Alarm function	Check that "ALARM LEVEL OF APNEA" is set to CRISIS at the "ALARM Setup" of the SYSTEM SETUP screen, and let the instrument generate the apnea alarm, and check that the red LED of the alarm indicator blinks.	Replace the CONTROL board or USER IF board with a new one if an error occurs.
	Make the instrument generate one of the following alarms, and check that the yellow LED of the alarm indicator blinks. - NIBP systolic pressure - Heart rate or pulse rate - SpO_2 data - Respiration rate	

NOTE

If changing the alarm setting for this check, return the setting to the original setting after finishing the check.

Clock

Item	Check Procedure	Action
Clock function	Check that the date and time is updated when the power is turned on.	If the clock stops while the instrument is turned off, replace the lithium battery on the CONTROL board with a new one. If the date and time are not correct, set the date and time correctly.

Optional Recorder Built in the Instrument

Item	Check Procedure	Action
Crack, scratch or dirt on the recorder	Check that there is no crack, scratch and dirt on the recorder.	If there is a crack or scratch on the screen, replace it with a new one. If the recorder is dirty, clean it with a soft cloth moistened with water.
Recorder function	Select "RECORDER" on the MANUAL CHECK screen, and perform the recorder check items, and check that there is no error. Refer to "Optional Recorder Check" in Section 3 of this manual.	Remove the cause if an error occurs.

Optional Transmitter Attached to the Instrument

Item	Check Procedure	Action
Crack, scratch or dirt on the transmitter	Check that there is no crack, scratch and dirt on the transmitter.	If there is a crack or scratch on the screen, replace it with a new one. If the transmitter is dirty, clean it with a soft cloth moistened with water.
Communication between the transmitter and instrument	Select "ZB-INTERFACE" on the MANUAL CHECK screen, and perform the check item, and check that there is no error. Refer to "Optional Transmitter Check" in Section 3 of this manual.	Remove the cause if an error occurs.

Safety

Perform the following patient safety check after repairing the instrument.

Item		Check Procedure	Action
Protective earth impedance (refer to IEC 60601-1-18.(f))		Check that the impedance between the protective earth contact and any accessible metal part does not exceed 0.1 Ω.	Remove the cause if the impedance exceeds 0.1 Ω
Earth leakage current (refer to IEC 60601-1 19)		Check that the earth leakage current does not exceed 0.5 mArms under normal condition and 1.0 mArms under each single fault condition.	Remove the cause if the earth leakage current exceeds one of the maximum values.
Enclosure leakage current (refer to IEC 60601-1 19)		Check that the enclosure leakage current does not exceed 0.1 mArms under normal condition and 0.5 mArms under each single fault condition.	Remove the cause if the enclosure leakage current exceeds one of the maximum values.
Patient leakage current (refer to IEC 60601-1 19)	Patient leakage current	Check that the patient leakage current to type CF or defibrillation-proof type CF applied part does not exceed 0.01 mArms under normal condition and 0.05 mArms under each single fault condition.	Remove the cause if the patient leakage current exceeds one of the maximum values.
		Check that the patient leakage current to type BF or defibrillation-proof type BF applied part does not exceed 0.1 mArms under normal condition and 0.5 mArms under each single fault condition.	
	Patient leakage current (mains voltage on the applied part)	Check that the patient leakage current to type CF or defibrillation-proof type CF applied part does not exceed 0.05 mArms under each single fault condition.	
		Check that the patient leakage current to type BF or defibrillation-proof type BF applied part does not exceed 5 mArms under each single fault condition.	
Dielectric strength (refer to IEC 60601-1 20)		Check that the instrument has the following withstand voltages. • A-a1: 1500 V AC for one minute • A-f: 1500 V AC for one minute • B-a: 4000 V AC for one minute • B-d: 1500 V AC for one minute	Remove the cause if the instrument does not have all the withstand voltages.

Installation Condition

Item	Check Procedure	Action
Installation condition check	Check that the instrument is installed in a suitable location according to the operator's manual.	If the conditions are not suitable, improve them.

Section 7 Replaceable Parts List

Replaceable Parts List 7.2

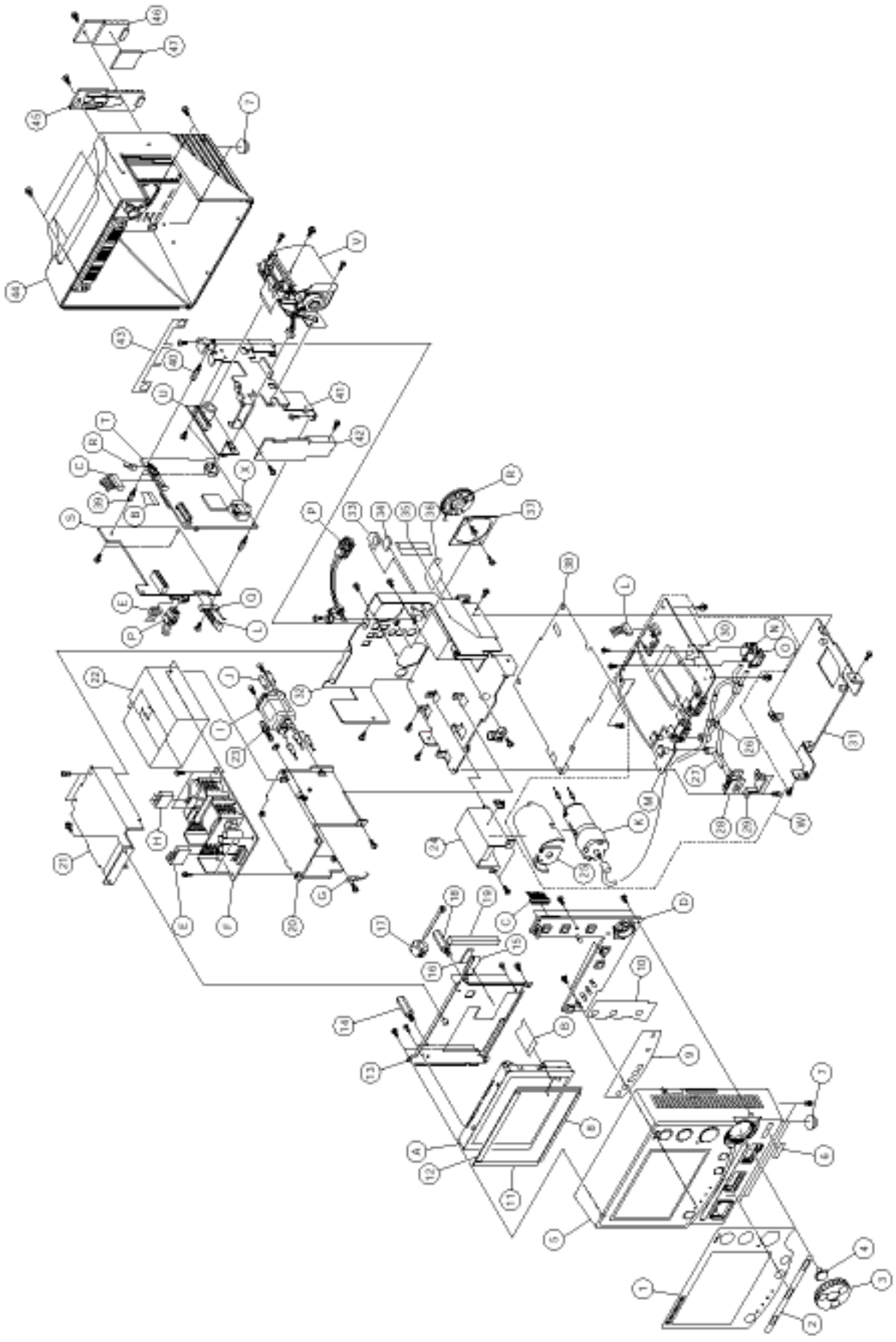
When ordering parts or accessories from your nearest Nihon Kohden Corporation distributor, please quote the NK code number and part name which are listed in this service manual, and the name or model of the unit in which the required part is located. This will help us to promptly attend to your needs. Always use Nihon Kohden parts and accessories to assure maximum performance from your instrument.

Replaceable Parts List

Index	NK Code No.	Description
1	6123-013132	Front panel
2	6124-034259	Parameter label
3	6113-041994	Rotary dial
4	6114-119534	Center key
5	6143-011827	Front enclosure
6	6124-034268	OPV-1500K label
7	624914	Rubber foot
8	6114-124234	LCD unit cushion 3
9	6114-121157	Key top panel sheet S
10	6114-121166	Key top panel sheet L
11	6114-124225	LCD unit cushion 2
12	6114-124216	LCD unit cushion 1
13	6112-015516	LCD unit holder
14	6114-124181	Hexagonal spacer bolt R
15	6114-126107	Flat ferrite core
16	6114-127944	Ferrite core cushion
17	631996	Ferrite core clamp
18	6114-124172	Hexagonal spacer bolt L
19	6114-126099	Shield gasket
20*	6112-016079	Power supply unit bracket
21	6113-042529	Top chassis
22*	6113-042378	Power supply unit insulation cover
23*	551734	Equipotential ground terminal
24	6113-042333	NIBP pump holder
25**	6114-120523	NIBP pump cushion
26**	6114-011193	Air tube 1
27**	6114-011201	Air tube 2
28**	6113-040469	NIBP socket
29**	6114-120505	NIBP socket holder
30**	6112-126186	INPUT board shield sheet
31	6112-015534	INPUT board shield cover
32	6142-002857	Main chassis
33	6114-124778	Battery protection sheet 4
34	6114-124769	Battery protection sheet 3
35	6114-124332	Battery protection sheet 2
36	6114-124243	Battery protection sheet 1
37	6114-120497	Speaker holder
38	6112-015659	INPUT board insulation sheet
39	624905	Spacer bolt
40	6114-124199	Hexagonal spacer bolt

* These parts are included in the SC-044R power supply block.

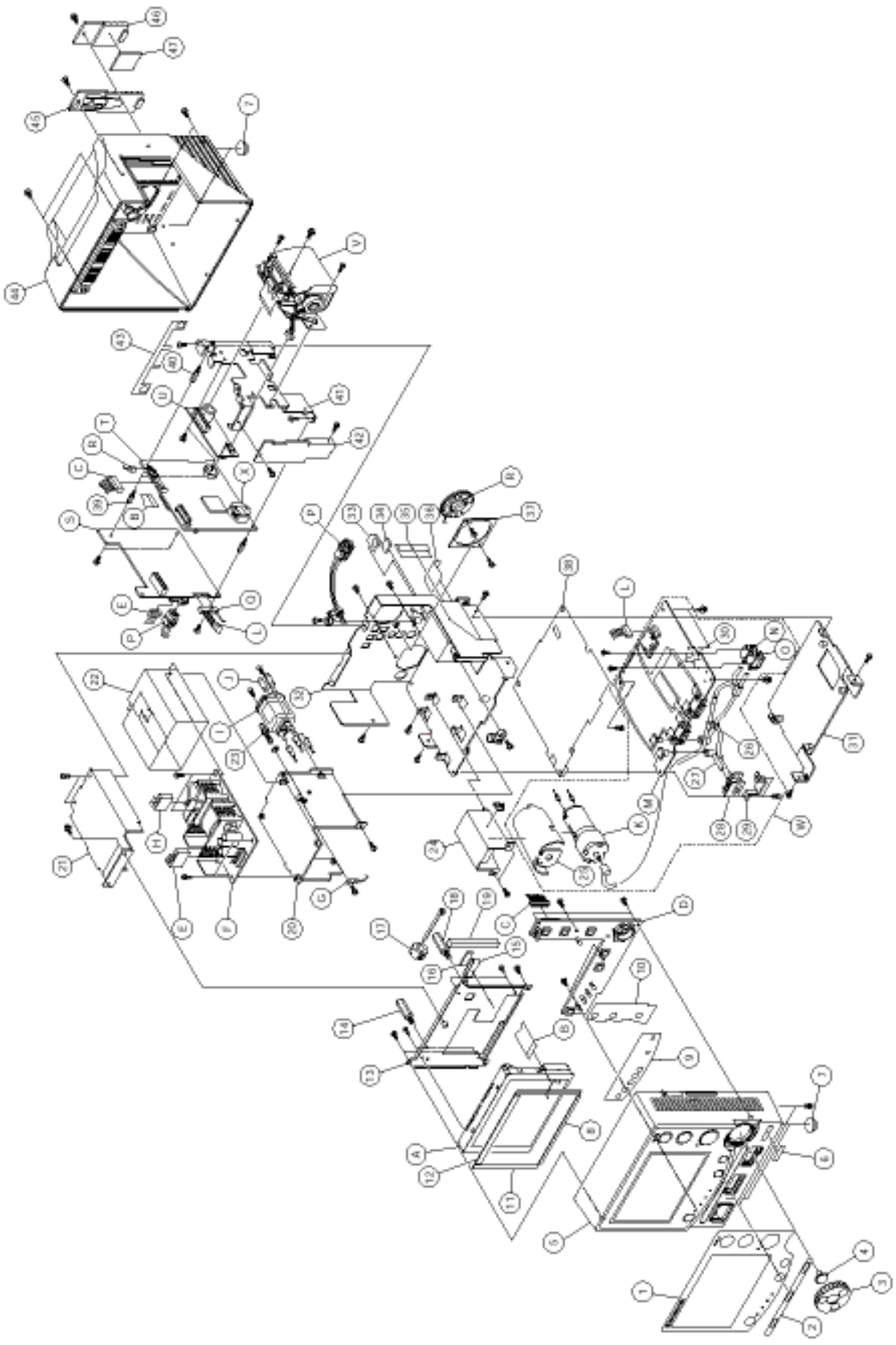
** These parts are included in the UR-3661 INPUT board.



Index	NK Code No.	Description
41	6112-015525	Recorder unit guide
42	6114-123797	Shield cover
43	6114-122753	Handle protection sheet
44	6111-006724	Rear enclosure
45	6113-042458	Socket cover
46	6114-120479	Battery cover
47	6114-122566	Battery cusion
A	618502	LCD unit
B	627305	CONTROL board - LCD unit wire harness
C	618672	CONTROL board - USER IF board wire harness
D	UR-3663	USER IF board
E	618699	POWER board - power supply unit wire harness
F*	550013	Power supply unit
G	627323	AC inlet socket - protective ground terminal wire harness
H	633557	AC inlet socket - power supply unit wire harness
I*	580676	AC inlet socket with fuse holder
J*	104522	Fuse T2.0 A/250 V
K**	620874	NIBP pump
L	618663	POWER board - INPUT board wire harness
M**	UR-3661	INPUT board
N**	622364	Solenoid valve 1
O**	611394	Solenoid valve 2
P	619109	POWER board - battery terminal wire harness
Q	627297	POWER board - NIBP pump wire harness
R	628198	Speaker (lead wires and connector included)
S	UR-3662	POWER board
T	UR-3665	CONTROL board
U	UR-3664	PRINTER CN board
V	RG-101W	Recorder unit (optional)
W	481809	Lithium battery for real-time clock

* These parts are included in the SC-044R power supply block.

** These parts are included in the UR-3661 INPUT board.



Section 8 Connector Pin Assignment

INPUT Board 8.1
- CN101 ECG/RESP Socket 8.1
- CN401 (for quick deflation valve, valve1) 8.1
- CN402 (for slow deflation valve, valve2) 8.1
- CN403 (not used) 8.1
- CN701 SpO_2 Socket 8.2
- CN902 (not used) 8.2
- CN1001 (for POWER board) 8.2

Power Board 8.3
- CN1 (for power supply unit) 8.3
- CN2 (for rechargeable battery) 8.3
- CN3 (for INPUT board) 8.3
- CN4 (for NIBP pump) 8.3
- CN5 (for CONTROL board) 8.4

USER IF Board 8.5
- CN101 (for CONTROL board) 8.5

PRINTER CN Board 8.5
- CN101 (for CONTROL board) 8.5
- CN102 (for recorder unit) 8.6
- CN103 (for recorder unit) 8.6

CONTROL Board 8.7
- CN1 Alarm pole socket 8.7
- CN2 (for LCD unit) 8.7
- CN3 (for POWER board) 8.8
- CN4 (for PRINTER CN board) 8.9
- CN5 ZB socket 8.9
- CN6 (for USER IF board) 8.10
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- CN8 (not used) 8.10
- CN9 (for speaker) 8.10

INPUT Board

CN101 ECG / RESP socket

Pin No.	Signal Name
1	NC
2	R
3	NC
4	L
5	NC
6	F
7	NC
8	R_RESP
9	NC
10	F_RESP
11	CONN_OFF
12	EG
13	EG
14	EG
15	EG
16	EG
17	EG
18	EG
19	R_EX
20	F_EX

CN401 (for quick deflation valve, valve1)

Pin No.	Signal Name
1	+6VM
2	E6

CN402 (for slow deflation valve, valve2)

Pin No.	Signal Name
1	NC
2	+6VM
3	E6

CN403 (not used)

Pin No.	Signal Name
1	+6VM
2	E6

CN701 SpO_2 Socket

Pin No.	Signal Name
1	LED_COM
2	FGND
3	PID+
4	FGND
5	FGND
6	FGND
7	FGND
8	FGND
9	PD_SHILED
10	PD_ANODE
11	LED_REX
12	LED_IREX
13	PID-
14	XCABLE_CONNECT
15	FGND
16	FGND
17	FGND
18	FGND
19	XCABLE_CHECK
20	PD_CATHODE

CN902 (not used)

Pin No.	Signal Name
1	+5V
2	GND
3	+5V
4	GND
5	+6V
6	GND
7	+6V

CN1001 (for POWER board)

Pin No.	Signal Name
1	+5V
2	GND
3	+5V
4	GND
5	+6V
6	GND
7	+6V
8	GND
9	PUMP_P
10	PUMP_M
11	H_TXD
12	H_RXD
13	L_TXD
14	L_RXD

Power Board

CN1 (for power supply unit)

Pin No.	Signal Name
1	+15V
2	+15V
3	GND
4	GND

CN2 (for rechargeable battery)

Pin No.	Signal Name
1	BATT+
2	THERMISTOR
3	BATT-
4	BATT-

CN3 (for INPUT board)

Pin No.	Signal Name
1	+5V
2	GND
3	+5V
4	GND
5	+6V
6	GND
7	+6V
8	GND
9	PUMP+
10	PUMP-
11	H_RXD
12	H_TXD
13	L_RXD
14	L_TXD

CN4 (for NIBP pump)

Pin No.	Signal Name
1	PUMP+
2	PUMP-

CN5 (for CONTROL board)

Pin No.	Signal Name
A1	+6V
A2	+6V
A3	+6V
A4	+6V
A5	+6V
A6	+6V
A7	+6V
A8	+6V
A9	6VGND
A10	6VGND
A11	6VGND
A12	6VGND
A13	6VGND
A14	6VGND
A15	6VGND
A16	6VGND
A17	GND
A18	GND
A19	GND
A20	GND
B1	+15V
B2	H_RXD
B3	L_RXD
B4	L_TXD
B5	H_TXD
B6	BATT_SYS0
B7	BATT_SYS1
B8	PW_SW
B9	PW_KEY
B10	PW_ON
B11	+5V
B12	+5V
B13	+5V
B14	+5V
B15	+5V
B16	+5V
B17	GND
B18	+12V
B19	+12V
B20	+12V

USER IF Board

CN101 (for CONTROL board)

Pin No.	Signal Name
1	+5V
2	+15V
3	AL3_Y
4	AL3_R
5	AL2_Y
6	AL2_R
7	AL1_Y
8	AL1_R

Pin No.	Signal Name
9	ALARM_key
10	ATU_key
11	INTVL_key
12	JOG_key
13	JOG_R
14	JOG_L
15	W/S_key
16	MODE_key

Pin No.	Signal Name
17	PW_SW_key
18	SW_PW_key
19	KETUATU_LED
20	CHRG_LED
21	DC_LED
22	AC_LED
23	DENGEN_LED
24	GND

PRINTER CN Board

CN101 (for CONTROL board)

Pin No.	Signal Name
A1	clock
A2	strobe
A3	D-in
A4	OE1
A5	OE2
A6	OE3
A7	TH1
A8	TH2
A9	OE4
A10	OE5
A11	Collector Opto
A12	Opto GND
A13	Anode Opto
A14	OE6
A15	D-out
A16	A
A17	/A
A18	B
A19	/B
A20	Vcc
B1	GND
B2	GND
B3	GND
B4	GND
B5	GND
B6	GND
B7	GND
B8	GND
B9	GND
B10	GND
B11	Vch
B12	Vch
B13	Vch
B14	Vch
B15	Vch
B16	Vch
B17	Vch
B18	Vch
B19	Vcc
B20	DRsw

CN102 (for recorder unit)

Pin No.	Signal Name
1	Vch
2	Vch
3	clock
4	strobe
5	D-in
6	GND
7	OE1
8	OE2
9	GND
10	GND
11	OE3
12	GND
13	TH1
14	TH2
15	OE4
16	GND
17	OE5
18	Collector Opto
19	Opto GND
20	Anode Opto
21	GND
22	OE6
23	D-out
24	Vcc
25	Vch
26	Vch

CN103 (for recorder unit)

Pin No.	Signal Name
1	A
2	/A
3	B
4	/B
5	Vcc
6	DRsw

CONTROL Board

CN1 Alarm pole socket

Pin No.	Signal Name
1	
2	
3	
4	+12V
5	NC

CN2 (for LCD unit)

Pin No.	Signal Name
1	HSY
2	VSY
3	CLK
4	NTP
5	HRV
6	VRV
7	VSW
8	CLKC
9	VCDC
10	VIN
11	VBS
12	BRT
13	VR1
14	VG1
15	VB1
16	GND1
17	VR2
18	VG2
19	VB2
20	GND1
21	VBL
22	VBL
23	GND2
24	GND2

CN3 (for POWER board)

Pin No.	Signal Name
A1	+6V
A2	+6V
A3	+6V
A4	+6V
A5	+6V
A6	+6V
A7	+6V
A8	+6V
A9	6VGND
A10	6VGND
A11	6VGND
A12	6VGND
A13	6VGND
A14	6VGND
A15	6VGND
A16	6VGND
A17	GND
A18	GND
A19	GND
A20	GND
B1	+15V
B2	HS_RXD
B3	LS_RXD
B4	LS_TXD
B5	HS_TXD
B6	BATT_STS0
B7	BATT_STS1
B8	PW_SW
B9	PW_KEY
B10	PW_ON
B11	AC_LED
B12	DC_LED
B13	CHRG_LED
B14	+5V
B15	+5V
B16	+5V
B17	GND
B18	+12V
B19	+12V
B20	+12V

CN4 (for PRINTER CN board)

Pin No.	Signal Name
A1	clock
A2	strobe
A3	D-in
A4	OE1
A5	OE2
A6	OE3
A7	TH1
A8	TH2
A9	OE4
A10	OE5
A11	Collector Opto
A12	Opto GND
A13	Anode Opto
A14	OE6
A15	D-out
A16	A
A17	/A
A18	B
A19	/B
A20	Vcc
B1	GND
B2	GND
B3	GND
B4	GND
B5	GND
B6	GND
B7	GND
B8	GND
B9	GND
B10	GND
B11	Vch
B12	Vch
B13	Vch
B14	Vch
B15	Vch
B16	Vch
B17	Vch
B18	Vch
B19	Vcc
B20	DRsw

CN5 ZB socket

Pin No.	Signal Name
1	XRSPW
2	GND
3	CNFM
4	+5V
5	ZB_RST
6	INIT
7	COM_RXD
8	COM_TXD

CN6 (for USER IF board)

Pin No.	Signal
1	+5V
2	+15V
3	AL3_Y
4	AL3_R
5	AL2_Y
6	AL2_R
7	AL1_Y
8	AL1_R
9	ALARM_key
10	ATU_key
11	INTVL_key
12	JOG_key
13	JOG_R
14	JOG_L
15	W/S_key
16	MODE_key
17	PW_SW_key
18	SW_PW_key
19	KETUATU_LED
20	CHRG_LED
21	DC_LED
22	AC_LED
23	DENGEN_LED
24	GND

CN7 (not used)

Pin No.	Signal Name
1	XRESET_S
2	FEW_S
3	MD2_S
4	TXD_S
5	RXD_S
6	+3.3V
7	GND
8	SCK2
9	SW_PW
10	PW_SW

CN8 (not used)

Pin No.	Signal Name
1	FRQ
2	GND

CN9 (for speaker)

Pin No.	Signal Name
1	SIG
2	GND
3	NC
4	NC

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